VOL. LXXXIV PART ELEVEN

JOURNAL OF THE ROYAL HORTICULTURAL SOCIETY

NOVEMBER 1959

PAGE

The Secretary's Page 481

Notes from Wisley. By N. K. GOULD 483

Lilacs. By F. P. KNIGHT, F.L.S., V.M.H. *Illustrated* . 486

Meconopsis Species and Hybrids. By A. EVANS. *Illustrated* 500

Masters Memorial Lecture, 1959: Plants and the Weather. Part II. By PROFESSOR J. P. HUDSON, M.B.E., G.M., M.Sc., PH.D., N.D.H. *Illustrated* 509

Plant to which an Award has been made in 1959. *Illustrated* 524

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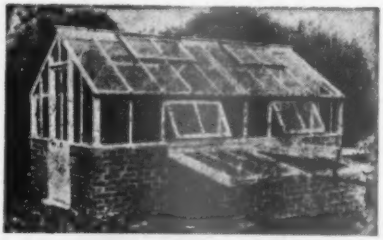

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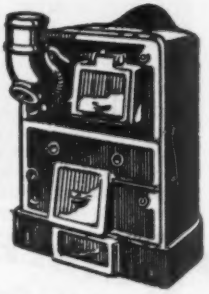

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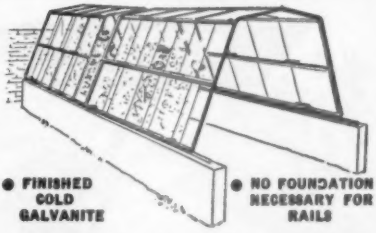

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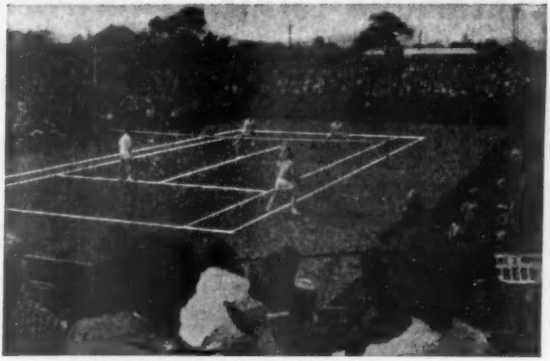

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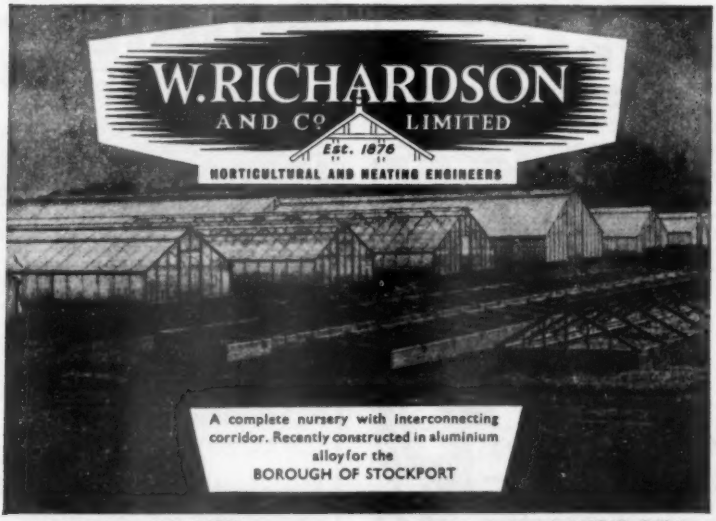
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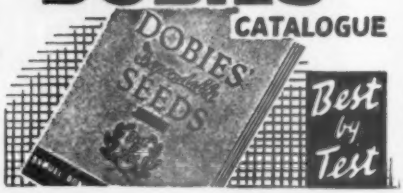

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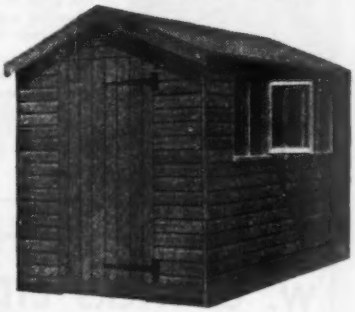

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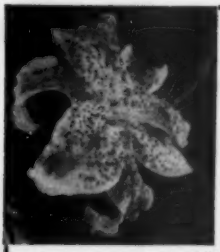

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JOURNAL OF THE ROYAL HORTICULTURAL SOCIETY

VOL. LXXXIV PART ELEVEN

November 1959

THE SECRETARY'S PAGE

ANNOUNCEMENTS—NOVEMBER AND DECEMBER

Shows

FRIDAY, November 6 1 P.M. to 7.30 P.M. SATURDAY, November 7 10 A.M. to 6 P.M.	National Chrysanthemum Society's Show, in the New Hall.
TUESDAY, November 10 12 NOON to 6 P.M. WEDNESDAY, November 11 10 A.M. to 5 P.M.	Fortnightly Flower Show, in the Old Hall.
TUESDAY, December 1 12 NOON to 6 P.M. WEDNESDAY, December 2 10 A.M. to 5 P.M.	Fortnightly Flower Show and Late Apple and Pear Competition, in the New Hall.

Lecture

TUESDAY, December 1, at 3 P.M. "Influence of Gibberellins on Plant Growth and Development", by DR. P. W. BRIAN, F.R.S.

Demonstration at Wisley—On Wednesday, November 18, there will be a demonstration on the Pruning of Fruit Trees, beginning at 11 A.M. The demonstration will be repeated at the same time on Thursday, November 19.

Distribution of Surplus Seeds—The annual distribution of surplus seeds from the Society's Gardens at Wisley to Fellows will take place during the first few weeks of 1960. A List of the seeds available, together with a Form of Application, is being sent with this JOURNAL only to Fellows resident overseas.

No copies will be sent to Fellows resident in the British Isles except on request. **Fellows resident in the British Isles** (including the Channel Islands and Eire) **who wish to participate in the distribution should apply immediately for the List and Form** to The Director (Seed Applications), The Royal Horticultural Society's Gardens, Wisley, Ripley, Woking, Surrey, and enclose a stamped, addressed envelope. **The completed Form must be returned so as to reach Wisley not later than December 31, 1959.**

The Society's Examinations in 1960—Candidates wishing to enter for the Society's Examinations in Horticulture to be held in 1960 are reminded that the closing dates for the receipt of entry forms are as follows: General Examination in Horticulture—Monday, January 11, 1960; National Diploma in Horticulture, Intermediate and Final Examinations, and N.D.H. Honours—Monday, February 1, 1960; Teacher's Diploma in School Gardening, Intermediate and Final Examinations—Monday, February 1, 1960.

International Orchid Conference, 1960—The Third World Orchid Conference, which is being sponsored jointly by the American Orchid Society, the British Orchid Growers' Association and The Royal Horticultural Society, will be held in London in 1960. The first conference was held in St. Louis, Missouri, U.S.A., in 1954, and the second in Hawaii in 1957.

The exhibition of orchids arranged in connexion with the Conference will be staged at the Chelsea Show on Tuesday, Wednesday, Thursday and Friday, May 24–27, and the Conference will be held in the following week on Monday, Tuesday, Wednesday and Thursday, May 30 and 31, June 1 and 2. Excursions to leading orchid growers' establishments will be arranged on Friday and Saturday, May 27 and 28, and on Friday, Saturday and Sunday, June 3, 4 and 5.

A joint committee of the three sponsoring bodies is arranging a comprehensive programme covering a wide range of subjects of interest to amateur and professional orchid growers, and orchid specialists from Australia, Belgium, Ceylon, Columbia, England, France, Germany, Japan, Malaya, South America, Sweden and the United States of America have already accepted invitations to deliver papers.

The Preliminary Programme is now available and anyone who wishes to have a copy should write to The Secretary, The Third World Orchid Conference, c/o The Royal Horticultural Society, Vincent Square, London, S.W.1.

NOTES FROM WISLEY

N. K. Gould

THE difficulty of writing weeks in advance about the probable state of vegetation in late autumn is greatly increased by an abnormal summer such as the one through which we have just passed. There is already plenty of indication that this season, said by some experts to have been the driest in some parts of these islands since 1921, has left its mark upon some of our most treasured trees and shrubs. Some appeared to be in distress as early as mid-summer, their leaves shrivelling and drying to some extent. Some lost their leaves prematurely and it is difficult to tell how they are going to behave. We have, in the past, frequently given advice about the proper treatment to be given to newly planted shrubs, and those who have followed our directions will, we hope, have found them advantageous. It has been an extremely trying time for any newly planted tree or shrub, but it has been possible to keep such things alive by watering whenever possible and by the application of mulching material. Some late-planted rhododendrons 8 or 9 feet tall have responded well to this treatment in the writer's own garden. They have, of course, made very little new growth and there has been a tendency towards the formation of a large number of flower buds for next spring. As it is undesirable to impose too great a strain on these bushes, most of the flower buds will be removed to encourage further vegetative growth. During the winter a fresh surface mulch of bracken and leaf-mould will be given.

We should not be in too great a hurry to dig up and discard any plant which seems to be in poor shape as the result of the long drought or exposure to too hot sunshine. Many plants are apt to shed their leaves and even to suffer some dying back of their top growth when too great a strain is placed upon the roots, but one should remember that, even so, the roots may still be reasonably strong and healthy and able to resume active growth again when the soil is thoroughly moist. Such plants as hydrangeas growing in too fully exposed positions may have suffered considerably in recent months, but if they are left alone at present and trimmed where necessary after the winter, they may be expected to make good growth once again.

It must not be concluded that all plants have suffered from this brilliantly sunny summer. On the contrary, some which generally give a rather half-hearted performance have surpassed themselves this year and fully justified even a long period of waiting. Among these one recollects the Trumpet Vines, *Campsis radicans* and *C. grandiflora*. They grow freely at Wisley but, in ordinary summers, they begin to flower just as the cool nights of September arrive, causing the buds to fall unopened. This year, the growth matured earlier and the plants

were in full flower at the end of August. Another plant which has put up a remarkable show is the hardy *Crinum powellii*, which has sent up its stout scapes to 5 or 6 feet, carrying huge bunches of pink or white lily flowers. The Belladonna lilies seem to have appreciated the sun's warmth and have responded by flowering early and with unusual freedom.

Among the annuals which have done especially well are the petunias, of which there was an extensive trial at Wisley, and the rudbeckias, which cannot be too highly recommended where vigorous and long-lasting annual plants are required. In the driest of beds against sun-baked south walls, the shrubby salvias and ceanothus have fully proved their worth, while *Cistus ladaniferus* can hardly ever have looked in such exuberant health.

The department responsible for producing these monthly notes deals with plant specimens sent to Wisley by Fellows for identification. These include, in addition to a very great variety of cultivated, ornamental and food plants, a certain number of wild British species and also alien plants which have become more or less established in this country as garden weeds. No doubt as a result of the hot summer some rather unusual plants have reached us. One is a species of *Cuscuta* (dodder) which has infested China asters, antirrhinums and gentians. We were unable to determine the species to which this parasite belongs but it is a strong-growing plant with thick yellowish stems. Like other species of dodder it seems to arise in the spring from self-sown seeds and rapidly to attach itself to the host plant, around which it twines and becomes affixed by means of sucker-like haustoria. The affected plant is soon completely enclosed in a web of tangled growths which make its further development extremely difficult. Unfortunately it is almost impossible to pull off the parasite, and we know of no selective herbicide which can be used to control it.

Two plants which come to us in large numbers every year are *Datura stramonium* and *Euphorbia lathyrus*. Both of these are European plants long established in British gardens and possibly becoming more common of late. The first is a very coarse growing annual weed which belongs to the family Solanaceae. Its erect stem forks repeatedly, bearing at each point large, dark green, evil-smelling leaves and funnel-shaped white flowers soon followed by large prickly fruits which give the plants its common name Thorn Apple. The plant has had some value in medicine, its leaves when dried having provided material used in the relief of asthma. The seeds and leaves are poisonous, so it is as well to destroy the plant as soon as it is noticed.

The euphorbia is a plant of very striking habit, developing in the first season an unbranched, erect, grey stem bearing four ranks of widely spreading narrow leaves. In its second year the upper part of the plant branches into a large bushy head bearing broader leaves and a great number of minute flowers which yield round green fruits. The idea that the unripe fruits provide a substitute for capers has given the plant

the popular name Caper Spurge, but like all the spurges it possesses in the green state at least some unwholesome properties and we do not recommend its use. It is however a plant of rather ornamental appearance and many people like to grow it in their garden. At the present time it is said to act as a repellent to moles, on the assumption that the roots give off an odour disliked by those creatures.

We occasionally receive specimens of henbane (*Hyoscyamus niger*) but this must be far less common than stramonium. Like that plant, henbane seems to have the knack of arising in places where the seeds have lain dormant for some years, so that it is said to appear on sites formerly occupied by buildings since demolished. This year we have been surprised to receive for identification specimens of *H. aureus*, a yellow-flowered henbane from the Near East, which is very tender in this climate.

Another species of the Solanum family which has appeared in greater numbers this year is *Nicandra physaloides*, a Peruvian plant of annual duration with rather pretty, pale blue, bell-shaped flowers followed by round berries enclosed in large papery calyces. A self-sown specimen in one garden reached a height of over 6 feet this year. This is the species largely advertised in the last year or two under the name "Shoo-fly Plant" and it is said that, grown as a house plant, it will repel flies.

Two other unusual plants are perhaps worth mentioning. The first is *Hibiscus trionum*, a bushy annual of the Mallow family whose place of origin is given in the reference books as the Tropics of the Old World. It has a yellow or white flower with a brownish centre which is worth close examination in order to see the delicately netted structure of the calyx. The other plant is *Abutilon avicennae*, which occurs wild in many parts of Europe. It is a rather coarse plant with large soft leaves and relatively small yellow blooms and is of no value in the garden.

Our correspondents usually enquire how such plants can possibly have arisen in their gardens and, indeed, it is frequently difficult to account for their appearance. There seems no doubt that many seeds come either as impurities in consignments of flower and vegetable seeds and it is possible that some may be introduced with other merchandise. Migratory birds may also be held responsible for some introductions. However this may be, such plants are interesting to see and very rarely cause trouble, except in such cases as the dodder referred to above and one or two other species which have become far too widely spread. One of the worst in this category we believe to be *Galinsoga parviflora*, popularly known as "Gallant Soldier", which originated in South America and now seems to have spread all over the globe. In the space of a very few years it has covered the commercial fruit trial grounds in Wisley Village and spread widely in the neighbourhood.

LILACS

F. P. Knight, F.L.S, V.M.H.

(*Lecture given on April* 21, 1959, MR. H. G. HILLIER, F.L.S., V.M.H., *in the Chair*)

THE name lilac is derived from the Persian word *lilak* which is apparently a variant of the Persian *nilak* meaning "bluish". It is generally applied to the numerous varieties of *Syringa vulgaris*, the common lilac, but may be taken to embrace the whole genus.

Complications in nomenclature often arise because Syringa is understood by many to be the popular name of *Philadelphus*, which should correctly be known by the common name of Mock Orange. In corresponding in an advisory capacity for many years on flowering shrubs I have on more than one occasion had to ask whether *Syringa* (lilac) is referred to or should it be syringa (*Philadelphus*) and I have received answers which proved that the name syringa is still in use for both genera.

MRS. SUSAN MCKELVEY in her monograph "The Lilac" explains how the name *Syringa* has grown up to be used in such a way and I cannot do better than quote what she writes:

"The word Syringa is derived from the Greek Syrinx meaning a shepherd's pipe, a flute, etc. OVID in his *Metamorphosis* tells the story of Syrinx, a nymph of Arcady, who, when pursued by Pan, was turned into a reed. From this reed Pan made the first flute or pipe of Pan." Of the Syringa G. DON (*Gen. Syst.* IV, 51, 1838) writes, "the branches are long and straight and are filled with medulla; hence the old name of the lilac, pipe-tree. LOUDON (*Arb. Brit.* II, 1208, 1838) also, "the tubes of the finest Turkish pipes are manufactured from the wood of this shrub and also from that of *Philadelphus coronarius*, hence the old English Pipe-tree, which was applied to both the Philadelphus and to the Syringa".

It is over twenty years since a talk on lilacs was given in the Royal Horticultural Society's lecture hall and then MR. H. G. HILLIER could only devote a limited period to the subject as part of a wider field on the occasion of the Conference on Ornamental Flowering Trees and Shrubs on April 26–29, 1938. A full report of his contribution is to be found in the Report of the Conference, pp. 101–11.

It is perhaps strange but the fact is that although the common lilac has been in cultivation in England for over three hundred years there is no book available written in England devoted to this shrub which is such a great favourite in our gardens. There is no lack of attention by song writers and poets and everyone knows "Come down to Kew in Lilac Time", by ALFRED NOYES.

Three books have been written in the U.S.A. about lilacs, the most important being *The Lilac*, by SUSAN MCKELVEY, *Lilac Culture*, by JOHN

C. WISTER and *Lilacs in My Garden*, by ALICE HARDING. There is also the invaluable check list *Lilacs for America*, which is now in its second edition, published by The American Association of Botanical Gardens and Arboretums. It is noteworthy that so much attention has been paid by Americans to the lilac when it is remembered that no species is native of their country.

I acknowledge my indebtedness to all the American literature referred to above but particularly to MRS. MCKELVEY's great work and to *Lilacs for America*.

The serious students of the genus will find most of what they require in MRS. MCKELVEY's Monograph, which extends to 581 pages. It was published by the Macmillan Company of New York in 1928 and is now somewhat difficult to acquire. I am the fortunate possessor of a copy which was given to me in memory of my very great young friend LIEUT. ARNOLD VIVIAN, Grenadier Guards, a most knowledgeable and enthusiastic gardener who was killed in Italy during the war. I have already said I am taking the title of my talk "Lilacs" to include the genus *Syringa* as a whole, but I do not intend to describe the twenty-five to thirty species which have been introduced to cultivation because frankly I do not regard all as plants worthy of general cultivation. Several must be restricted to scientific collections in our Botanic Gardens. I have decided to give attention to the following species which I think are of merit as ornamental plants and in helping to make my choice I have spent considerable time in checking current catalogues of many nurserymen who cultivate a wide range of trees and shrubs to ascertain what are available.

Syringa josikaea. The Hungarian lilac. Although there will be some who may not deem this worthy of a prominent position in the garden I like it for its good foliage and deep lilac-coloured flowers which are borne in terminal upright inflorescences on the current year's wood in June and stand well above the leaves. This species, which may eventually attain a height of up to 12 feet, is a native of Hungary and first flowered in cultivation in Great Britain at the Royal Botanic Garden, Edinburgh, in 1833. *S. villosa* introduced from N. China in 1885 is similar in general appearance to *S. josikaea* and is considered to be perhaps more attractive because of its lighter coloured flowers. It does not, however, seem to be generally obtainable from nurserymen at the present time.

Syringa julianae. Introduced by E. H. WILSON from W. China in 1901, is an attractive small growing shrub reaching to about 6 feet high. The flowers which are fragrant, are freely produced in late May and early June; they are lilac-purple outside and whitish inside. The leaves are small and the branching is dense. This is a desirable shrub for a small garden.

Syringa microphylla. A neat growing shrub introduced from China in 1910. The lilac-pink flowers are freely borne in May and often a second flowering is seen in late summer and early autumn. The variety

'Superba' received an Award of Merit from The Royal Horticultural Society when shown on August 13, 1957.

Syringa persica. The Persian lilac. A very old favourite, the true origin of which is still thought to be somewhat obscure. For a long time it was considered to be a native of Persia but subsequently it was established that the cut-leaved variety *laciniata* was a true native of China. In fact only this form has ever been found truly wild. The Persian lilac has been in cultivation in this country for about three hundred years. Both in its lilac-coloured and white-flowered forms it is frequently seen in flower in May. I am particularly fond of the white-flowered variety. The variety *laciniata* is not often seen but is of interest because of its lobed leaves. A small shrub with fragrant flowers.

Syringa pinnatifolia. By including this species in my selection I realize I have departed from the standard I set by considering only species of ornamental value. My excuse for bringing in *S. pinnatifolia* is that many of us like to have a plant which differs from its relatives as to seem as though it should be placed in another genus. I think we like to puzzle our visitors. *S. pinnatifolia*, as its name implies, has pinnate leaves and thus varies from nearly all other lilacs. It is a native of W. China, from whence it was introduced by E. H. WILSON in 1904, and in cultivation forms a neat growing bush about 6 to 8 feet high. In May it produces white flowers slightly tinted with lilac.

I have in my garden a hybrid between this species and *S. oblata* var. *giraldi* which was raised in the Arnold Arboretum near Boston in Massachusetts, U.S.A., and named *S. diversifolia* 'William H. Judd' after the Kew-trained propagator who worked for so many years in that famous garden. This hybrid shows intermediate characters between the parents and there will be seen growing on the same bush true simple leaves, pinnate leaves and those which are nearly entire but having one or two freakish-looking lobes. The whitish flowers are not without attraction and I look forward to the development of my plant with much interest.

Syringa reflexa. This in itself is not only one of the most attractive lilacs in cultivation but is also one of the parents of a comparatively new race of hybrids, raised at Ottawa, and named collectively *S. prestoniae* after the raiser MISS PRESTON. These will be described later. *S. reflexa* is an introduction by E. H. WILSON from Hupeh, Central China, and the first plants in England were raised from seeds at Kew in 1911. The specific epithet describes the habit of the terminal inflorescences which are reflexed or nodding, and being freely produced they give the whole plant an unusual appearance as they droop earthwards. This character comes out strongly in a hybrid between *S. reflexa* and Swegiflexa (*reflexa* × *sweginzowii*), aptly named 'Fountain' because the flowers resemble fountain jets. But to return to *S. reflexa*, the flowers which appear towards the end of May and overlap into June are rich purplish pink outside and whitish within, and are arranged all around the main flower stalk. The leaves are very striking in appearance, being rough

to the touch, very dark green on the upper surface and paler beneath. They will measure up to 8 inches in length on young vigorous shoots. This is a hardy species worthy of cultivation in every garden and may eventually reach a height of 10 to 12 feet.

Syringa sweginzowii. Another Chinese introduction by MR. WILSON, who sent home seeds in 1904. This grows into a bush about 12 feet high and in June bears neat panicles of fragrant pale rosy lilac flowers which are whitish inside the tubular corolla. The variety "superba" is also in cultivation and is, in fact, the one usually offered by nurserymen. Although from its name this is regarded as being superior to the type species it is interesting to note that BEAN attributes any superiority it may have to good cultivation and REHDER thought it scarcely different.

Syringa tomentella. A strong growing species introduced by E. H. WILSON from W. China in 1908, this may attain a height of from 10 to 15 feet. It was for a time named *S. wilsoni*. The flowers which appear in early June are, when young, deep lilac pink becoming paler with age, and at the finish almost white. This is an attractive shrub but apparently not readily obtainable nowadays.

Syringa velutina. This I believe to be the correct name of the lilac often exhibited at spring shows as *S. palibiniana*. It is erroneously described as a dwarf lilac, but this is perhaps because it will flower very freely when no more than 1 foot high. For this reason it is grown in pots and included among pans of alpine plants or planted on small table rock gardens. To add to the confusion I have also seen this plant grown as *S. microphylla*. It will, I am sure, prove difficult to get everyone who grows this most attractive shrub to be consistent in their labelling, but all will agree that the plant has many uses because it is slow growing. I know of one particularly shapely specimen growing very happily on a paved terrace. The numerous panicles of pinkish lilac flowers are borne on the dense twiggy branches in May.

Syringa yunnanensis. A shrub of rather neat growth, up to about 8 feet high, introduced from Yunnan by GEORGE FORREST in 1906. The flowers are borne in terminal panicles in May, the buds are fawny pink opening to lilac-pink, then through pink to die off nearly white. It is such changes in colour as this which make it almost impossible to refer to precise colour descriptions when trying to identify lilacs by means of a colour-chart. MR. HILLIER states in the Conference report referred to previously "this was the best lilac species flowering at Winchester this year".

SYRINGA HYBRIDS

Available records show that considerable hybridization has been carried out between various *Syringa* species and varieties and anyone desirous of delving deeply into this particular aspect of lilac breeding is referred to the accounts which appear in various publications. In presenting the following condensed notes I have been governed mainly by selecting

for mention lilacs of hybrid origin which are usually available for planting in gardens, but I have also included a little advance knowledge about some new plants which are just appearing on the market.

Syringa × *prestoniae*. This as explained under *S. reflexa* is the group name given to a race of hybrid lilacs which originated at the Central Experimental Farm, Division of Horticulture, Ottawa, Canada, and named after MISS ISABELLA PRESTON, who commenced the hybridizing in 1920. The parent plants were *S. villosa* and *S. reflexa* and it is interesting to note that E. H. WILSON in his book, *Aristocrats of the Garden*, prophesied that *S. reflexa* might form the forerunner of a new race of lilacs.

It is recorded that numerous plants resulting from MISS PRESTON's work were named, but most of these were eventually discarded and a high standard set to ensure that the best only were perpetuated.

The first plants from this new development appear to have reached England in 1935 when LORD BESSBOROUGH, who was Governor-General of Canada, introduced them to his garden at Stansted Park in Hampshire. An account of this was written by his head gardener, the late MR. T. E. TOMALIN, in the R.H.S. JOURNAL for September 1941, p. 312. It will be noted at once that the common lilac, *S. vulgaris*, had no part in the production of the new race and the varieties raised bear no resemblance to lilacs as generally visualized. Varieties of *S. prestoniae* are vigorous growing shrubs with large dark green leaves and large terminal panicles of flowers borne in June on the current season's shoots. The scent of the flowers resembles that of privet.

The flower colours range from almost whitish pink through coral, pink, and deep pink to pinkish crimson and crimson-magenta and there is a striking contrast between flowers of different ages on the same bush. This character makes the identification of plants from cut flowers very difficult. This race is very hardy and fine specimens are to be seen in the Royal Botanic Garden, Edinburgh, but as the plants tend to produce their new growth early in the spring a little care should be taken not to plant them in a known frost pocket.

I have grown at least a dozen named varieties of *S. prestoniae* and my own choice now would be:

'Audrey'. This has large plume-like panicles in which the pinkish mauve flowers are loosely arranged.

'Elinor'. A very attractive variety with dark purplish red buds opening to pinkish lilac flowers.

'Isabella'. Named in honour of MISS PRESTON, with large rather upright branching panicles with purplish buds opening to a lighter purplish lilac colour.

'Romeo'. Pinkish mauve flowers when fully opened but deeper coloured in bud.

'Virgilia'. Deep lilac-magenta buds opening to fine paler coloured flowers.

Syringa × *josiflexa*. This is the group name for hybrids raised in Ottawa in 1920 by MISS PRESTON between *S. josikaea* and *S. reflexa*. There is a general resemblance to the hybrids of the *prestoniae* group, particularly in the fine deep green foliage. I would restrict my choice to two of the resultant varieties namely:

'Bellicent'. This is my favourite among all the lilacs raised at Ottawa. It is recorded that this was a seedling from *S.* 'Guinevere', which was one of the original seedlings of the cross. 'Bellicent' has magnificent terminal panicles of rose-pink flowers without any trace of the harder purplish magenta which is seen in many of the Ottawa hybrids (Fig. 163). It was awarded the R.H.S. First Class Certificate when first exhibited on May 28, 1946, and is the only one so far of MISS PRESTON's hybrids to be so honoured.

'Lynette'. This has light graceful panicles of lilac-pink flowers, the leaves tend to become variegated.

'Kim' which resulted from a cross between *S. josikaea* and an unknown parent received the R.H.S. Award of Merit on June 3, 1958. This has mallow purple flowers.

Syringa chinensis. The Rouen lilac. This is a grand old favourite often seen in gardens and parks as a large shrub up to 10 feet high and as much in diameter. It is a natural hybrid between *S. persica* and *vulgaris* and originated in the Botanic Garden at Rouen about 1777. The name *chinensis* was used because at one time it was thought this was a species from China. The habit of growth and the flowers tend to resemble *S. persica*, the leaves and flowers are smaller than those of *S. vulgaris* and the individual branches are thin and arching. The fragrant lilac-coloured flowers are produced in twin panicles and the flower petals tend to become reflexed as the flowers age. I find this variety requires careful pruning as left to its own devices the branches become far too crowded and many fail to flower. There are several synonyms for *S. chinensis*.

Syringa × *henryi* 'Lutece'. This is the name given to a lilac which resulted from a cross made at the Jardin des Plantes in Paris by PROFESSOR HENRY between *S. josikaea* and *villosa*. It has perhaps only a slight claim to be included in a choice for the garden but recalling plants which I saw growing as young vigorous specimens in nursery lines with attractive dark green leaves, upright habit of growth and deep violet-coloured flowers carried well above the branches in late May, would decide me to find a place for it in my own garden.

Syringa × *swegiflexa*. The only variety in this group which is available has been named 'Fountain' and this originated at Ottawa as the result of crossing *S. reflexa* back on to a hybrid between *S. sweginzowi* and *reflexa*. MISS PRESTON, who raised this variety, likens it to a fountain when the drooping panicles of pink flowers appear in May.

Syringa vulgaris × *oblata giraldi*. Hybridization between the above

parents has been practised mainly by W. B. CLARKE at San José, California, and has resulted in plants of a high quality. Not all of these are readily available at present, but the following selection includes old and new varieties:

'Alice Eastwood'. Raised by CLARKE in 1942, having claret-purple buds opening to double cyclamen-purple flowers.

'Buffon'. Raised by LEMOINE in France in 1921, this is an early-flowering single variety with lovely soft pink flowers.

'Clarke's Giant'. This created a sensation in the U.S.A. and already has a good reputation in this country. Raised by CLARKE it is a vigorous grower with immense panicles of soft bluish single flowers which are at least 1 inch in diameter. The buds are rosy mauve.

'Esther Staley'. Raised by CLARKE and named in 1948, this is described in the U.S.A. as the best pink single-flowered lilac in cultivation and the young plants I have seen in flower in this country confirm this description (Fig. 161).

'Lamartine'. Another early-flowering variety raised by LEMOINE in 1911 and which with 'Buffon' can claim to give lilac-time a send off. It bears single mauve-pink flowers and is a variety which I think should be seen more frequently.

There are other hybrid lilacs available to those who seek for them and although there now appears to be a lull in hybridizing in France we may expect new plants from America from the firm of W. B. Clarke and from Dropmore, Manitoba, where DR. F. L. SKINNER has been hybridizing between *S. vulgaris* and *oblata dilatata*, and he recently sent several named varieties to Wisley.

SYRINGA VULGARIS VARIETIES

I deliberately omitted *S. vulgaris* from my list of species because the common lilac is too well known to need a description and also because it is superseded by the numerous named varieties. I am not forgetting, however, the great value of this plant, which is so adaptable and is seen in so many unexpected places growing well and bringing cheerfulness each May to many an otherwise dreary spot. Dwellers in towns know what they owe to their common lilac bushes. It would not have been difficult to confine the whole of this account to varieties of *S. vulgaris*, in fact it would be difficult to know when to stop. MRS. MCKELVEY gives the names of over four hundred varieties in her Monograph and occupies nearly two hundred pages in describing these inclusive of the species *S. vulgaris*. No records exist of the number of varieties in cultivation in this country and as the result of scrutinizing many nurserymen's current catalogues it is clear that in common with other popular genera of shrubs there has been a movement since the end of the war to cut down the number of varieties grown. However much this may be

deplored it must be remembered that for economic reasons a nurseryman must decide that where two or more varieties are very much alike he should select what he considers to be the best and discard the others. It will readily be seen this immediately cuts down costs of cataloguing, stock-taking, labelling and invoicing, among other things. It seems to me that there is a case for planting up in some public garden or park a comprehensive collection and this should be kept correctly labelled. In the current guide book of the Arnold Arboretum, U.S.A., it is recorded that 450 varieties are grown and that it is not unusual for 50,000 visitors to view these on one day.

The scrutiny I carried out of the catalogues of thirteen British nurserymen specializing in the supply of flowering trees and shrubs revealed that altogether forty-three single-flowered and thirty-four double-flowered varieties are offered but only one from each set, namely, 'Souvenir de Louis Spath' (single) and 'Mme. Lemoine' (double), are offered by all. I compiled a list of what appear to be the most popular varieties in current supply and demand as follows:

LILACS

Single Flowered		*Number out of 13 nurserymen offering*
Souvenir de Louis Spath	deep reddish purple	13
Massena (Fig. 164)	deep reddish purple, large flowers	10
Congo	lilac-red becoming paler	8
Glory of Horstenstein	purplish red	
Marie Legraye	white	
Primrose	pale primrose yellow	
Jan Van Tol	pure white	7
Charles X	purplish red	6
Clarke's Giant	rosy mauve in bud opening to very large pale blue flowers	
Marechal Foch	bright-carmine rose, tall growing, upright in habit	
Reaumur	deep carmine-violet	
Etna	claret purple, late flowering	5
Double Flowered		
Mme. Lemoine	double white	13
Charles Joly	dark purplish red	12
Katherine Havemeyer	purplish-lavender	
Michel Buchner	clear lilac	11
Mrs. Edward Harding	reddish-purple becoming lighter	10
President Grevy	bluish lilac	9
Belle de Nancy	lilac-pink	6

Alphonse Lavallee	bluish-lilac, outside of flowers darker than inside	3
Ami Schott	deep cobalt blue with paler reverse	
Condorcet	lavender	
Edith Cavell	cream-yellow buds then pure white	
General Pershing	purplish violet	
Marechal Lannes	carmine buds opening lilac violet	
Mme. Antoine Buchner	rosy pink shaded with mauve	
Miss Ellen Willmott	white	
Olivier de Serres	pale mauve	
Paul Deschanel	deep carmine buds opening to rosy mauve	
Paul Thirton	carmine buds opening to claret-rose	

The choice of certain varieties in preference to others is a matter of personal taste and for myself I would not adhere to the lists in the order given. There is little doubt, however, that within this range are to be found lilacs of very high quality. It should be borne in mind that new varieties of similar or even superior merit will gradually become available and may displace or downgrade some of those listed. I would advise keeping a constant review and such varieties among others as 'Maud Notcutt', 'Sensation', 'Alice Eastwood', 'Esther Staley', 'Blue Hyacinth', 'Kate Sessions' and 'Monique Lemoine' will, I feel certain, be seen more frequently in the near future.

Maud Notcut	very large, single white
Sensation	single, bright-purplish red, edged with silver white
Monique Lemoine	double white
Blue Hyacinth	single tubular hyacinth-like mauvish blue flowers
Kate Sessions	single, early flowering purplish mauve

It would not be right in any account on lilacs to omit mention of the great debt we owe to the firm of Lemoine of Nancy, France, for the very important work they have carried out in raising new varieties and for the original work of VICTOR and EMILE LEMOINE in raising double-flowered varieties.

CULTIVATION OF LILACS

Lilacs can be seen thriving in a variety of soils and positions, but to see them at their very best with large heads of healthy flowers and good foliage they should be planted on a soil which is not too light or sandy in texture and certainly not of an acid nature. Therefore they show a preference for a good loamy soil and if this contains lime so much the better. A badly drained site should be avoided and also one which is

too shady, for although the bushes will grow in shade they tend to make a lot of leafy growth and not many flowers. It should also be remembered when selecting a planting site that a May frost can cause a lot of damage just as the buds are unfolding. Planting may be undertaken from the end of October until mid-March and I prefer to plant bushes not more than three or four years old. If planting in groups, I would allow about 8 feet between the bushes, and although this arrangement does look somewhat sparse to begin with, it is quite easy to find suitable plants for ground cover—but a word of warning here; do not plant vigorous covering plants too near to compete with the bushes.

It is absolutely useless expecting flowers typical of the varieties to be borne by newly planted bushes, in fact, I would say at least three or four years are required after planting before good flowers are seen. I do not allow flowers to develop on any plants the first year after planting and for several years I remove the old flowers directly they begin to fade, but I realize, of course, that bushes of, say, 10 feet and over would present a problem and many good displays are seen on plants of this size which do not have the old flower heads removed.

Pruning. No regular system of pruning is required, but I would always be on the lookout for thin spindly twigs and remove these and also cut out inter-crossing branches which tend to form dense growth. It does not appear to be generally known that large overgrown specimens may be rejuvenated by drastic pruning. Sawing through the main branches even up to 4 inches in diameter and no more than 3 feet from the ground can be safely done in the winter months. The usual warning must be given about taking care in undercutting the branch to avoid splitting the wood. The newly sawn surfaces should be smoothed off with a sharp knife and the wounds coated with one of the proprietary preparations specially made for the purpose. Strong new shoots will develop and within about three or four years these will produce flowers of a quality vastly superior to those previously borne on the old worn-out wood (Fig. 156.)

Feeding. Lilacs benefit by an annual mulch of compost, which is more readily obtained than farmyard manure. I believe in a general tidy up in the winter when the opportunity arises, lightly pricking through the surface and adding the mulch. A dressing of bone meal at the rate of two or three ounces to the square yard in February or early March is also well worth while.

Propagation. The amateur gardener will not generally be concerned with raising new bushes and the professional nurseryman will use the method or methods he finds most profitable. I feel, however, that some general observations are called for, particularly as there is promise that by using mist technique propagation more plants will become available on their own roots.

Whenever writing or lecturing on plant propagation, I always arrange my sequence by starting with the most natural way and that is raising plants from seeds and then on through the whole range of

methods finishing up with the artificial operations of budding and grafting.

Commencing then with seeds, these could only be relied upon to reproduce truly the parent plant where this is a true species and has been grown in isolation. This is rarely possible and seeds, particularly from botanic garden collections, often result in giving plants which vary from the type. There is excitement, of course, in looking out for promising offspring in the hope of finding a new variety worth perpetuating.

Seedlings are easily raised from seeds sown in pots or boxes in an ordinary soil mixture in the winter months and placed in a cold frame or greenhouse.

Layering is the next most natural method and where branches are conveniently situated to enable them to be pegged into the ground this method is simple and trouble-free and does not require any particular skill. I prefer to select a single cleanly grown shoot about 12 inches long from two to four years old and in the late autumn bury a portion of this about 4 inches deep in the ground. The buried portion should be sharply bent so that the growing point sticking out of the ground is as near upright as possible. This is important, partly to retard the free flow of sap from the parent root to the tip of the branch and also in order to obtain a shapely new plant. I do not make any incision with a knife into the wood of the buried portion, but I do scrape away some of the bark, although this is not strictly necessary. It is usually necessary to wait about eighteen months between the time of putting down the shoot until this is removed with sufficient roots to ensure the new young plant is self-supporting.

Cuttings. I have tried raising many varieties of *S. vulgaris* from cuttings but until recently without much success. It was not that the cuttings did not root, but the rate of growth was so slow afterwards as to render the method not generally worth while. MR. HILLIER dealt with this subject twenty years ago in his contribution to the 1938 Conference previously referred to. He hit the nail on the head when he stated in connection with using soft cuttings "the time between taking the cuttings from the mother plant and their insertion should be as short as possible, and in order to ensure they do not become dry, a damp cloth or box containing damp moss makes quite a good receptacle in which to gather them". But twenty years ago we did not have polythene bags and mist technique propagation and now by using these the old difficulty referred to has disappeared. First it is essential to take very young cuttings in May, selecting the newly developed shoots when these are no more than 3 to 4 inches long and carefully making the cuttings with a very sharp knife just at the point where the new wood joins the old. Immediately the cuttings have been removed from the parent plants they should be put into a polythene container and taken to the modern propagating house equipped with the apparatus which provides the intermittent mist spray. Here each cutting can be made

and inserted and it will be found the majority will root in a few weeks. The young plants are then potted and hardened off and planted in the open ground in the spring following. I have seen good bushy plants 18 inches high in two years from this method. Nearly all *Syringa* species can be quite easily raised from hard wood cuttings inserted in winter in frames or in open beds made up of sandy soil but *S. vulgaris* and its varieties do not respond to this method (Fig. 155).

Grafting and Budding. Despite all the criticism that has been levelled against raising lilacs by grafting or budding these on to different stocks, I am certain that more plants are still raised by nurserymen using these methods in preference to all others and vigorous young plants true to name are produced more quickly than from cuttings or layers. I feel having watched the position for many years that much of the criticism comes from those who have not taken the trouble to make themselves thoroughly conversant with the different methods. There is no doubt that "the suckering nuisance" has to be dealt with when seedlings of *S. vulgaris* are used as the stocks.

In order to assist in identifying suckers some nurserymen use stocks of the white-flowered *S. vulgaris* on which to "work" the coloured named varieties and the coloured form on which to "work" the white varieties. One soon gets an "eye in" for the difference between stock and scion and the suckers can be spotted at an early stage and their removal thus expedited. When it is remembered that the majority of flowering trees, fruit trees, roses, hybrid rhododendrons including azaleas, are raised by grafting or budding and we take the trouble of looking out for and removing suckers as a normal routine operation, I cannot help remarking that perhaps a little too much has been made of the bogy of lilac suckers. The actual method of grafting is simply splicing the scion on to the lilac stock as near to the root as possible. This is done in February and March and the newly joined sections are bound together and waxed over with grafting wax and then usually planted in a cold frame and covered with lights for a few weeks until they have grown together. Grafting on to oval-leaved privet (*Ligustrum ovalifolium*) is still largely practised, particularly on the Continent and the latest method I have seen of this technique has much to recommend it. The grafting is done by uniting the lilac scions on to the privet stocks and waxing these over and planting them direct into the open ground so that the point of union is buried. Privet does not sucker from underground and after about two years the lilac will produce its own roots above the point of grafting and the privet stock which has fulfilled its purpose as a temporary nurse will completely die away. There is nothing in this method of propagating which can be reasonably objected to, as it results in lilac bushes on their own roots. In the past the method was much more crude than the present specialized one and for that reason we did see ugly swollen stems.

Budding is carried out in July and is still used in this country to increase lilacs, using *S. vulgaris* raised from seeds as stocks. It is

possible to "run up" single stems to a height of 4 feet for the purpose of developing "standards" but the demand for these is more limited nowadays than in the past. Standards are often produced on stems of oval-leafed privet.

Forcing. The forcing of lilacs is a very specialized operation and nearly all the flowers sold by florists come from Aalsmeer in Holland. Forcing is not often practised in this country and it is not thought necessary to describe the technique.

COMMON PESTS OF LILACS

Lilac Leaf-Miner (*Caloptilia syringella* F.)

Damage. Larvae mine the leaves forming blotch mines which turn brown. Leaves also rolled conically. The mines are found between June and September.

Control. (1) Hand-pick and burn infested leaves where possible.

(2) Spray thoroughly with B.H.C. (2–3 applications at 14-day intervals).

Privet Thrips (*Dendrothrips ornatus*)

Damage. Mottling of leaves with pale silvery spots.

Control. Spray when damage is first seen with lindane, malathion, or dust with lindane. Repeat 10–14 days later.

Caterpillars

Damage. Leaves eaten.

Control. Spray or dust with DDT.

Scale Insects (*Chionaspis salicis* and *Fonscolombia fraxini*)

Damage. Shoots covered with greyish-white scale. Leaves may be blackened in severe infestations due to harmless sooty mould growing on honeydew excreted by the scale insects.

Control. (1) Where practicable, scrape off as much of scale as possible.

(2) Spray 2–3 times at fortnightly intervals with malathion or nicotine-white oil emulsion (1 oz. 95 per cent Nicotine: 1 pint Summer White Oil: 10 gal. water).

Leopard Moth (*Zeuzera pyrina*)

Damage. Stems and branches tunnelled by large caterpillars causing die-back.

Control. (1) Cut back to end of tunnel and burn.

(2) Where cutting back is not desirable find entrance hole (usually with sawdust underneath it). Insert paradichlorobenzene crystals and plug with clay or putty.

DISEASES OF LILACS

Lilac Blight is caused by the bacterium *Pseudomonas syringae* which lives in the cortical tissues of old infected shoots and shows in spring

about flowering time when the young green shoots and flower trusses droop and wilt. Such shoots are seen to be blackened and soon wither up. It is important to cut off such affected shoots well behind any sign of infection and this should be sufficient (without any spray treatment) on good vigorous bushes. This disease may be confused in some seasons with late frost damage but usually this point is settled by noticing that only some of the young shoots on one bush are affected OR only *one* of *twin* flower trusses has wilted. Cold, damp, spring weather seems to encourage this disease.

Honey Fungus (*Armillaria mellea*). This attacks many kinds of shrubs and lilac is no exception. It is a subterranean parasite attacking the roots underground and rarely seen above ground. Wherever it appears any infected shrub must be lifted as completely as possible, all roots gathered for burning and no old stumps ever left in the soil. It is on old stumps this fungus thrives and sends out runners (rhizomorphs) like bootlaces which seek to infect roots of other shrubs. It is believed that soil drainage is important and where this is inefficient the Honey Fungus is encouraged to grow.

Leaf Spots. There are various fungi which sometimes cause brown spots on lilac leaves but none is considered of importance or to need special treatment. Usually the attacks by such fungi on the leaves is due to weakness in the foliage and the best remedy is to study soil conditions and make sure the bushes are able to develop good roots and obtain proper nourishment.

Verticillium Wilt. Sometimes a whole bush or half of it wilts and the leaves mostly fall off leaving a few at the tips of the shoots. This can be due to the fungus *Verticillium albo-atrum* killing parts of the root system and such bushes can only be grubbed out and burnt. This disease is mainly one of nursery stock and cannot be considered a common trouble.

In conclusion I acknowledge with sincere thanks my indebtedness to DR. R. HOWARD, the Director of the Arnold Aboretum, U.S.A., Messrs. R. C. Notcutt of Woodbridge and MR. J. DYTER and MR. L. MAURICE MASON of Fincham for the valuable help they have given me in providing many of the coloured slides which have illustrated this talk. I am also grateful to DR. F. L. SKINNER of Dropmore, Manitoba, for information about his work on hybridizing and to members of the staff at Wisley Gardens who have helped with photography and preparing the specialized matter on Pests and Diseases.

MECONOPSIS SPECIES AND HYBRIDS

A. Evans

(*Royal Botanic Garden, Edinburgh*)

(*Lecture given on June* 23, 1959; G. TAYLOR, D.SC., V.M.H., *in the Chair*)

I AM certain there are others who know more about meconopsis than I. I do not intend this to be a botanical thesis on the genus however; rather it is a horticultural survey of many of those species and varieties in cultivation today. Some may not be readily obtainable but with the exception of three, all are growing in the Royal Botanic Garden, Edinburgh.

In their quest for garden plants collectors have searched the world but so far, with the exception of *Meconopsis cambrica*, Asia has provided all the meconopsis. It is also interesting to note, that although a number of species are widely distributed, many have local ambitions and do not inhabit wide areas. Furthermore, the alpine screes and high scrub-covered slopes are the self-elected homes of these plants. That so many flourish and remain in our gardens on being transferred to positions of our choosing, in a climate such as they must never have experienced and at low altitudes, shows their high degree of adaptability. I know few are self-supporting and the majority require artificial aid if they are to persist but this little effort is well rewarded by the results. In the woodland, semi-wild garden and larger rock garden their requirements appear to be met, for there they seem to find the conditions which suit them best. In these selected positions they are more able to tolerate our unkind winters and so grace the scene another year. The density of shade necessary varies with the geographical location of the garden, and in the South obviously greater shelter from the sun and wind must be provided.

Although the well-known 'Blue Himalayan Poppy', *M. betonicifolia*, is perennial the greater number of meconopsis are monocarpic, i.e. they die after flowering. Many in fact are biennial, while others may take as long as five or six years to reach flowering size, this being no disadvantage, however, as the unflowered rosettes are exceedingly handsome. With each succeeding year these rosettes increase in circumference and many a gardener dreads the day his pet rosette decides to flower. It is small consolation to know that abundant seed is guaranteed for, alas, a familiar figure has disappeared!

Putting sentiment aside, however, the following method of raising plants has been found successful. Seed, after harvesting, is kept in a cool place until the middle of March when it is sown thinly in pots in the John Innes seed compost. The pots are placed in a glasshouse where the minimum night temperature is 55° F. Shading is given and within three weeks germination has taken place after which the usual

practice of giving more light to the seedlings is carried out, although never are the plants given unshaded sunlight. When grown on a large scale for one's own use certain meconopsis do not take unkindly to being pricked out into a frame but where only a few plants are grown, or if they are to be dispatched from a nursery, all the monocarpic species are better potted into 60's. In the case of *M. dhwojii*, *gracilipes*, *sherriffii*, *bella*, *delavayi* and *violacea*, potting is strongly recommended. The pricking out distance should be 2½ inches apart both ways, after which the seedlings are watered and shaded until they have recovered and started to grow. By the end of May or early June the sashes can be removed from the frames but if the young leaves are not to be scorched temporary shading is necessary. During this early growing period moisture should always be available. It is also important to avoid overcrowding the young plants otherwise they become leggy and, on being lifted from the frames, the roots are so entangled that too much soil must be shaken from them before they can be separated with the result they need time to recover. The plants are usually at the ideal stage for planting out towards the end of July or beginning of August.

Where a heated glasshouse is not available, seed may be sown immediately it is gathered and the pot or pan placed in a north frame. If germination is rapid and the young plants become crowded they may be pricked off into boxes or pots and overwintered under glass but the seed pot should be retained as a further germination is likely in the spring. When only a few plants germinate in the autumn they can be left in the seed pots and providing the compost is not overwatered they should come to no harm and can be handled in spring.

Because of the ease with which meconopsis can be raised there is a tendency to plant them thickly. Nothing is gained by this type of planting and much is lost for not only must the plants compete with one another for moisture and light but they do not develop as they should. Few of these rosette-forming plants should be less than 18 inches apart and in some cases 2½ feet separating the plants is not too much. Once in their permanent quarters and growing strongly it is a mistake to transplant them for, even with care, so many of the long roots are broken and damaged that the plants rarely fully recover. The evidence of this is seen when these disturbed plants bloom for their flowering spikes are usually much shorter, more poorly developed and far less decorative.

The genus *Meconopsis* can be divided conveniently into two groups, those which are polycarpic and those which are monocarpic. Primarily I will deal with the perennials as they, because of their permanency, have a wider appeal. It is but seemly to start with *M. betonicifolia* (*M. baileyi*) as this plant must be grown more extensively than any other. Unquestionably it is a reliable plant which has bright blue flowers arising in the axils of the upper leaves as well as terminating the shoots. It is highly effective when planted in a clump or when drifted through shrubs or herbaceous plants where it enjoys partial

shade. Not all the flowers are a good blue, however, and the less attractive shades are better rogued at flowering time. While *M. betonicifolia* may be raised by division of large clumps in spring it is easily raised from seed. It is a strange fact but most of the seedlings which flower the year after planting die and plants which have grown less vigorously during that year and do not flower are perennial. It has been said that removing of the flowering shoot encourages crown buds to form at the base of the plant so that plants which would normally have been biennial become perennial but this is not too reliable and only in some cases will this happen. It is as though the rhythm of the plant has become atuned to flowering and although frustrated is still unable to alter its tempo. The leaves closely resemble those of the betony and it is due to this similarity that it has been so named. Although it is over 70 years since this species was first discovered the credit of introducing it goes to the late KINGDON-WARD, who collected it as *M. baileyi* in 1924, in S.E. Tibet. Recently a white form appeared in a number of gardens and although it can never replace the Blue Himalayan Poppy, it is a good white and is interesting. From seed saved and sown of this white form at least 80 per cent of those which have flowered are white.

M. grandis is also a popular plant. It, too, is blue and very handsome but here the leaves are more or less entire although some forms do have slightly serrated leaves. It has a stature of approximately 4 feet and has large drooping flowers but on the whole is not so robust as *M. betonicifolia*. Sikkim and Nepal are its native countries. It responds to the same cultural treatment as the previous species, coming into flower a week or two earlier, harmonizing with the woodland planting. It also has a white form with large drooping flowers but in this case the white is not so pure.

Growing as they do in close proximity it was inevitable that hybrids would appear and the well-known *M.* × *sheldonii* was the result. This hybrid stands 5 feet in height, has flowers which are a wonderful bright blue and in the best form the flowers, clustered together, are carried on pedicels 12 inches in length (Fig. 153.)

M. simplicifolia closely resembles *M. grandis* by having simple leaves which are clustered round the base of the plant. The 3-foot-high flower stalks are completely devoid of foliage whereas in *M. grandis* the pedicel, no matter how long it may be, always arises from a collar of leaves. Some forms are persistent for a few years but others are more or less monocarpic. The light blue form, which is taller growing and more showy, is the one which invariably dies after flowering. It is thought BAILEY discovered this plant in Tibet in 1913. A situation near the front of a shaded side of a border will admirably suit this species.

No one, save possibly CAPTAIN R. D. TROTTER, can say *M. delavayi* is an easy plant to grow, but perhaps that is due to it not yet being fully understood. It grows in Yunnan at high altitudes and inhabits limestone areas but it is doubtful whether the lime is available to the plant. Named in honour of the French missionary, PERE DELAVAY, it barely

FIG. 151—*Meconopsis punicea* at Keillour Castle, near Perth (see p. 503)

FIG. 152—*Meconopsis* × *sarsonsii* at the Royal Botanic Garden, Edinburgh (see p. 506)

Photo: A. Evans

FIG. 153—*Meconopsis* × *sheldonii* in the Inshriach Nurseries, Aviemore, Invernessshire (see p. 502)

Photo: J. E. Downward

FIG. 154—Iris 'Sylphide' A.M. May 25, 1959. A fine Reglio-cyclus hybrid shown by Messrs. C. G. van Tubergen Ltd., Holland (see p. 524)

Photos: N. K. Gould

FIG. 155—Lilac 'Congo' 18 months from a soft wood cutting inserted under intermittent mist. Size of cutting shown on left (see p. 496)

FIG. 156—Lilac. Showing young growth in August after cutting back old plant in Spring. New growth should be drastically thinned (see p. 495)

FIG. 157—*M. discigera* in the Royal Botanic Garden, Edinburgh (see p. 505)

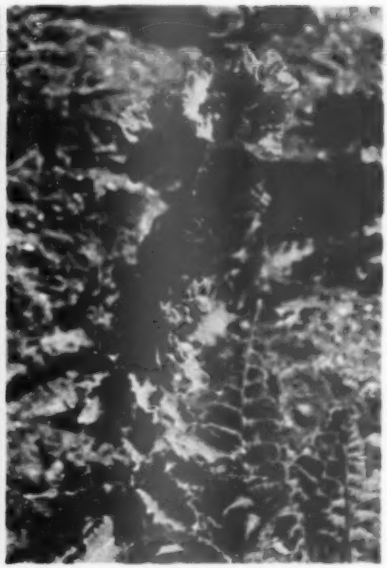
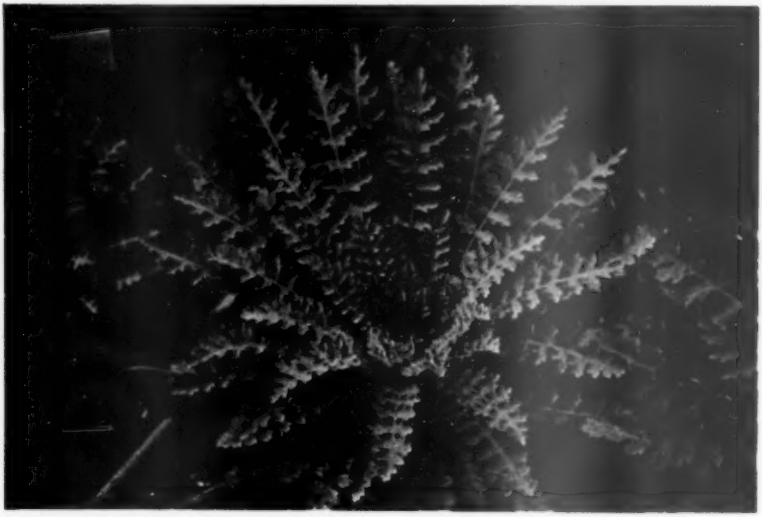


FIG. 158—*M. latifolia* also in the Royal Botanic Garden, Edinburgh (see p. 505)



Photos: Royal Botanic Garden, Edinburgh

FIG. 159—*M. gracilipes* S.S.W. 8473. Winter rosette photographed in March (see p. 507)

FIG. 160—*Meconopsis* S.S.W. 7943. Royal Botanic Garden, Edinburgh (see p. 508)

Photo: R. C. Notcutt

FIG. 161—Lilac 'Esther Staley' (see p. 492)

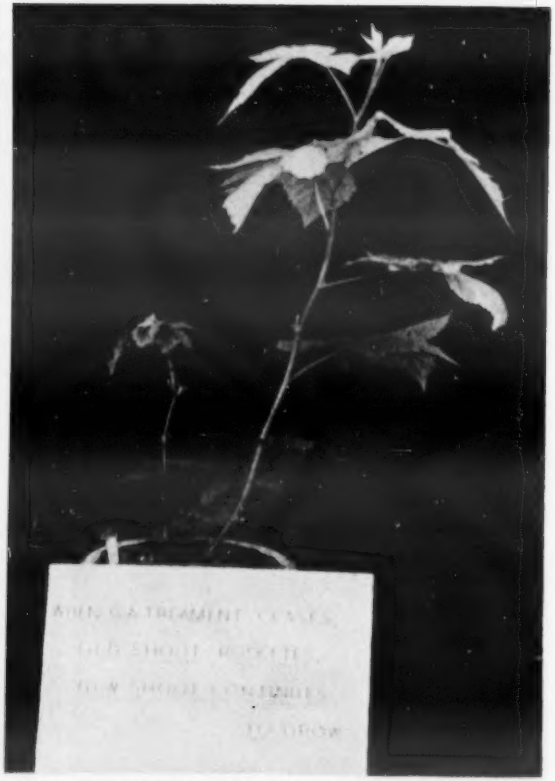
FIG. 162—*Effects of gibberellic acid on raspberry shoots*

All these plants were grown in a controlled environment under 'autumn' conditions at 50° F. and 8-hour photoperiod, in which the raspberry shoot normally ceases to elongate and forms a terminal rosette of leaves (see p. 521)

(*a*) Control plants showing terminal rosette

(*b*) Weekly application of gibberellic acid to the growing point cause the shoot to continue to elongate under conditions where it would normally rosette

(*c*) If applications of gibberellic acid continue, not only does the treated shoot (*left*) grow in height, but elongation occurs of the basal shoot (*right*), although that shoot does not itself receive treatment



(*d*) If treatment of the original shoot (*left*) ceases, that shoot reverts to the rosetted condition, but the basal shoot continues to grow long after treatment ceases

Photo: T. H. Findlay

FIG. 163—Lilac 'Bellicent', a fine seedling raised in Ottawa from hybrids between *Syringa osikaea* and *S. reflexa* (see p. 491)

Photo: J. A. Dyter

FIG. 164—Lilac 'Massena' (see p. 493)

reaches 6 inches but the crowns can be dense, producing numerous flowers which may measure 2 inches across. These are deep purple and slightly drooping.

The smallest of all this genus is *M. bella* and unfortunately it is one of the rarest in cultivation. It is a difficult plant to keep for the ideal conditions to suit its needs are still unknown. It has done fairly well in a shaded part of a rock garden and has flowered when planted in a rich soil but rarely does it persist for any length of time. It is an attractive miniature with bright blue, upturned flowers which are carried on slender 4-inch-long pedicels. The leaves may be deeply cut or simple but whichever form is tried it still remains a challenge to the cultivator.

M. quintuplinervia in the northern parts of the British Isles is a fairly easy plant to establish but apparently is more difficult in the south. There are really two forms of this species, one which colonizes an area in record time and another which is less invasive and if anything produces more flowers. It is sometimes referred to as the Harebell of the Himalaya and it is a desirable plant where conditions suit it. Peaty soil in partial shade in a site where it can wander amongst medium-sized rhododendrons seems to be the setting. The lilac-shaded, dainty, drooping flowers have a charm and quality of high merit. *M. quintuplinervia* is readily increased by dividing the large clumps in early spring just as growth is beginning.

M. punicea is obviously a near relative of the preceding species having a similar type of flower and habit of growth although not being so long-lived a perennial. The flowering stems are longer and the flowers larger but more striking is the colour of the petals which is a vivid red. It is also more floriferous but unfortunately it is not to be found in many gardens (Fig. 151). Where it does grow it seems to like the same sort of conditions as those enjoyed by *M. quintuplinervia* but its scarcity in gardens indicates, only too well, its fickleness.

A hybrid claiming *M. punicea* and *M. quintuplinervia* as parents is *M.* × *cookei*. It is intermediate between its parents in every way but in no way is it an improvement. It is an easy plant in cultivation, propagation being fairly easily done by division. Unfortunately the colour of the flowers is rather dowdy for the delicate lilac of one has not blended with the bright red of *M. punicea* to make an outstanding shade. It is, however, an interesting hybrid which appeared in MR. COOKE's garden at Corbridge, and in MR. HARLEY's garden at Glen Devon in the same year.

M. sherriffii is not the easiest member of this genus to grow and more fail than succeed in cultivating it. In certain gardens it does appear contented and sets seed in fair quantities. It is strange, however, that under what would appear to be similar conditions in another garden, it refuses to grow. Evidently it likes the usual conditions one aims at providing for primulas, a rich soil which does not dry out in summer. Being only 18 inches high it should not have too much competition

from neighbouring plants. The flowers are a delicate shade of pink and are produced singly so that one cannot expect this species ever to be smothered in bloom. This is of little consequence once the plant is established for every flower deserves individual appreciation. The leaves are pubescent, simple and form a cluster at the crown of the plant.

M. chelidonifolia is a fairly easy plant to grow but no doubt its scarcity is entirely due to its lack of appeal. Growing as it does 4 to 5 feet through an open shrub with its purple black stems its small yellow flowers are held poised at the end of long fine pedicels. The whole plant has a languid appearance, as though the conditions were too exhausting for it. In fact a plant growing in a garden in the south preferred to trail on the ground rather than produce upright stems but when transferred to the Royal Botanic Garden it assumed an erect habit. Young plants can be induced to form in the axils of the upper leaves if the stems are pegged down and this sprawling manner may be normal. *M. chelidonifolia* does not care for too much sun or very strong winds and when shelter is not available the delicate stems, leaves and flowers wither and turn brown. It has coarsely divided foliage, not unlike *Chelidonium*, and even more plants can be obtained by dividing the clumps in spring.

Another yellow perennial is *M. villosa*, a much more colourful species than *M. chelidonifolia*. Unfortunately it does not take kindly to having its roots disturbed and will not divide with ease but, as so much seed is yielded and germination is good, there should be no difficulty raising stock. The broad, deeply lobed leaves are glaucous on the undersides and when fully grown completely protect the surface roots from the sun. It is a very handsome species with branching flower stems up to 2 feet or more high and the large open, bright yellow flowers suitably terminate these shoots. In actual fact more than a century has passed since this species first flowered in Britain and for many years it was grown as *Cathcartia villosa*. Although it has been found growing in open situations in the wild a partially shaded site seems to suit it better in cultivation.

It would hardly be right to conclude my remarks on perennial meconopsis without alluding to our own native species. If *M. cambrica* were a difficult plant no doubt great pains would be taken to cultivate it but because of the ease with which it spreads it has been termed a weed. There is a form nevertheless with yellow or orange double flowers which is worthy of mention. It is inclined to be a trifle garish and more in keeping in the herbaceous border amongst the other bright florist's flowers. Like the species it is not a tall growing plant but a clump of *M. cambrica flore pleno* makes a valuable contribution to the border in early summer.

Having disposed of most of the true perennials I think a note on the short-lived species might be profitable. Those I bracket in this category all have blue flowers and are almost without exception biennial. They are not tall growing and one or two can be found homes in the larger

rock garden without unbalancing the rest of the planting. In fact one species in particular will colonize a rocky slope and without any effort from the grower freely seed itself each year. This means that there are always flowering and non-flowering plants dotted around. The others cannot be relied upon to do this unaided and in their case it is better to raise young plants every year in the controlled space of the propagating yard.

M. aculeata differs from *M. horridula* by having leaves which are lobed rather than entire. This leaf character is supposed not to be constant but the nicely lobed leaves of some forms of *M. aculeata* are very distinctive. As a protection against grazing animals this small plant is efficiently armoured with sharp bristles making seed collecting a very unpleasant task. The flat open flowers vary in shade from light blue to purple and usually clothe a simple spike 18 inches high.

M. horridula is well named for the spines on the leaves, stems and calyces of this species are really horrid. It is a useful plant, however, with strap-shaped leaves which sometimes have purple dots on the leaf surfaces at the bases of the spines. One or more flower stems may arise from the base of the plant and the flowers vary tremendously in hue. Diligent selection could, no doubt, produce a uniform strain but it is doubtful if this is desired for in the galaxy will be found as many individuals as admirers. Moisture is essential if they are to grow satisfactorily and rock crevices on a north-facing slope where the roots can find shade, appear satisfactory. Certainly an open bed planted with this species can suffer dreadfully in a dry season such as we are experiencing just now.

The most stately of the trio, which are obviously all rock lovers, is *M. latifolia* and it is pleasant to relate that this fine species is the one most able to look after itself, seeding in the spaces between the rocks and flowering year after year in an effortless manner. Three and a half feet is not an uncommon measurement and so upright and majestic are these flowering spikes that it is little wonder the demand for seed is so great. Flowers are borne in great profusion on the tall racemes and the flower colour which is a pure light blue has its centre filled with the numerous yellow anthers. The leaves are bristly, large and broad with crenate margins and have a glaucous sheen. It is many years since *M. latifolia* was first collected but there are still numerous rock gardens where its presence would be an asset (Fig. 158).

M. discigera, while not strictly a biennial, does not persist for long. It is monocarpic and though many plants will bloom during their second year there are others which may take a further year to reach flowering size. This species does not like dense shade and a more open situation should be chosen for it. It is always fascinating to watch a plant come into growth and very few are more intriguing than this one as its overwintering bud unfolds. The leaves are entire but extremely hairy and as they emerge the crown takes on the appearance of a beautifully made bird's nest. Finally, the stem elongates until eventually it

reaches 4 feet or more and the blue flowers begin to expand. These are light blue when first they open but by the time the petals fall the colour has changed to a dark shade of purple. This results in the flowering spikes having numerous shades of blue at the one time. The diagnostic character of this species is the disc which surmounts the ovary much as one finds in the poppy (Fig. 157).

M. integrifolia seems so much apart from the other species that it is difficult to form comparisons. This species has enormous yellow flowers sometimes measuring 6 inches or more across and although there are many forms, varying in the size and shape of the flower, the large-flowered form with incurved petals, sometimes known as the Lamp Shade Poppy, is the best. *M. pseudointegrifolia* was the name given to the flat-faced form at one time. This species is monocarpic and mostly biennial, the semi-drooping flowers being borne on long pedicels. It will not grow well other than in light shade, reaching 15 to 18 inches in height with long obtuse basal leaves and a few stem leaves. It evidently grows wild over large areas of the Himalayas and is one of the earliest to flower.

It is not surprising that *M. integrifolia* has been used as a parent by a number of hybridists and a MR. SARSONS of East Grinstead was the first to make a controlled cross between this species and *M. betonicifolia*. Although the hybrid had appeared spontaneously in other gardens about that time it is in his honour that the hybrid was christened *M.* × ***sarsonsii***. In manner of growth and even in the shape of the flower the hybrid closely resembles the polycarpic parent but its flower colour varies from cream to light yellow (Fig. 152). Although not truly a monocarpic plant this hybrid lives only a few years but seed saved and sown comes reasonably true to type. As the young leaves emerge from the resting bud the pubescence is more golden than in *M. betonicifolia* but the leaf shapes are almost the same. It is an interesting hybrid and shows the possibilities that do exist in the genus.

The next group of meconopsis to be considered are those which, although monocarpic, may take a number of years to reach maturity. They all more or less have leaves which are winter hardy and with each succeeding year expand in stature until finally they flower and die. Seed, however, is yielded in abundance and there ought to be no difficulty in raising stock but some seed must be retained for sowing the following spring in case, as happens on occasional years, no plants flower. This is the only way to keep the gaps in the flowering years closed. Furthermore certain of those species, with leaves which are covered with very fine hairs, may have to be protected in wet winters otherwise crown rot may set in and the plants decay. In semi-woodland conditions, in association with rhododendron and herbaceous perennials these meconopsis seem at their best.

Dealing firstly with the yellow-flowered species, *M. dhwojii* is one which is widely grown. Of all this group it appears to be the one which resents planting out most and losses are almost certain unless the plants

are pot grown. The foliage is fern-like, delicate and is dark glaucous green with numerous purple spots scattered over the leaves. This is an added attraction during the time the rosettes are developing. When in flower the plant resembles a pyramid or cone as the growth of the lateral flowering branches seems to keep pace with the tip of the main shoot as it elongates.

M. gracilipes is a less robust species than *M. dhowjii* and does not have purple dots at the base of the bristles on its leaves. Otherwise it is a similar sort of plant with light yellow flowers and very fine foliage. Furthermore, the shape of the plant at flowering time differs in being more columnar than pyramidal. Because of its less vigorous nature it is not so often seen but a well-grown plant can be extremely decorative. Central Nepal is its native habitat where it has been found in altitudes up to 16,000 feet (Fig. 159).

No wild garden could be termed complete without a few plants of *M. paniculata*. It is reliable and ornamental whether in or out of flower, and although the 5-foot-high handsome spikes may be greatly admired the view of a clump of densely hairy, light greyish green rosettes with leaves which are cut and lobed is difficult to surpass.

M. regia is well named, for the unflowered rosettes, 3 or 4 years old, must be as handsome a sight as anyone would care to see. They can quite easily measure 2½ feet across and are densely covered with rich golden yellow hairs. Summer or winter, the tracks to these plantings are well worn and the proportion and balance of the crowns never fail to impress. It is fortuitous that this of all the species should choose to be patient and refrain from flowering early. The leaves are practically entire except for a few small shallow serrations on the margin. It is an imposing plant in flower, the yellow blooms being approximately 4 inches in diameter and carried on branching stems. Like all the other rosette-forming meconopsis it resents being disturbed once it is planted out and established. Usually the plants are induced to flower earlier after they have been disturbed but very reduced flower spikes result. Protection in winter is necessary in some localities.

M. superba is a near relative of *M. regia* and requires a similar situation among scattered shrubs and in partial shade. This species, however, has silvery grey leaves and the flowers instead of being yellow are white. In addition each pedicel carries only one flower and is not branched as it is in *M. regia*. It also has a limited distribution and even there reports say the colonies are not over-populated.

Perhaps the most widely cultivated of the monocarpic species is *M. napaulensis*. This is not surprising for it has been in cultivation more than 100 years and it is not uncommon to find self-sown seedlings. The rosettes are large and attractive and are made up of deeply cut leaves. The hairs covering much of the leaves are reddish brown so that this tinge is given to the leaf colour. It grows best in a sheltered site free from wind where it is not subjected too long to the rays of a warm sun otherwise the edges of the leaves may dry out and turn brown.

M. napaulensis reaches flowering size in two or three years when, in July, plants 6 feet high are commonplace. The colour varies greatly from blue, purple and wine even to white. The flowers are borne on branching pedicels and many are out at the same time.

M. violacea is a near relative of *M. napaulensis* but it is a much less robust plant with violet flowers. They are not in such profusion for in most instances the flowering laterals are simple, having only one flower, but its delicate form and fine leaves make it a distinctive plant.

This really concludes this section and in fact could conclude my talk but in recent years a number of new kinds of meconopsis, I daren't say species lest they be but varieties of those already existing, have been introduced and I should just like to finish by showing a few illustrations of some of these unnamed plants. It is quite likely many people will have grown them, and flowered them, and will have formed their own opinions. Certainly this STAINTON, SYKES and WILLIAMS' collection of meconopsis has made an excellent additional contribution to our alien woodland flora.

Meconopsis sp. S.S.W. 7943 was sown in the spring of 1955. This plant was most distinctive for as it grew the leaves developed a lovely golden brown sheen, due to the thick covering of hairs. When a number of plants flowered the following year, 1956, the pink flowers were of a shade never seen before in this type of meconopsis (Fig. 160). The shape of the leaf and the flower characters more or less conformed to those of the species, *M. napaulensis*. Nevertheless it is almost certain to be a variant of that plant. Seed was then collected and sown in 1957 and this progeny has flowered, bearing flowers of the same shade. It is to be hoped that it continues to breed true to the form first introduced.

Meconopsis sp. S.S.W. 8483 has enormous rosettes up to 3 feet across. The leaves are not so coarsely cut as the usual *M. napaulensis* and seem midway between that species and *M. paniculata*. The two rosettes shown flowered this year, one reaching 8 feet and the other almost 6 feet. The taller growing specimen had light pink flowers while the other had flowers of a reddish wine shade. The leaves seem so different to either species that I hesitate to suggest a name.

Meconopsis sp. S.S.W. 8506. Of the many numbers sent in by these collectors many of them look alike but this one is quite different and is not unlike *M. superba* at this, the unflowered stage. In fact one almost expects to see white flowers appearing when it comes into bloom. I am afraid I have no slide record of this plant in flower but it has flowered in an unattractive shade of lilac and the spikes were barely 2 feet high. If this is the best it has to offer long may it remain immature for the unflowered rosettes are at least a feature.

Finally, *Meconopsis sp. S.S.W. 8620* must be termed "la pièce de résistance " of the collection, for these rosettes are almost 3 feet across. This species was introduced as *M. regia* red, and no doubt it is *M. regia* but not all the flowers were red. Many were yellow while others had petals which were yellow but with red tips. Whatever the final epithet

for this plant may be or even if it is never properly classified, our garden would be much the poorer if it were lost. I am glad to say that so far seed saved from plants which have flowered in this country have germinated and are growing vigorously and long may this be the report.

This completes my survey and I trust I have been able to illustrate how variable the genus is and how worth while meconopsis are as garden plants.

MASTERS MEMORIAL LECTURE, 1959

PLANTS AND THE WEATHER

J. P. Hudson, M.B.E., G.M., M.Sc., Ph.D., N.D.H.

(*Lecture given on April 7, 1959*; H. V. TAYLOR, C.B.E., D.SC., V.M.H., *in the Chair*)

PART II

THE CHAIRMAN: A fortnight ago PROFESSOR HUDSON told us something which was quite new and most astonishing, and, so far as I am concerned, most unexpected. He said he and his colleagues have been doing some research work at Nottingham University on fruiting plants, and it so happened they had chosen the raspberry. He showed us, with slides, that if they grew raspberry canes in almost a summer temperature the whole of the year, they produced no fruit buds in the axils of the leaf, they produced no side shoots, no blossoms and no fruit. A raspberry cane which goes up and up, producing only leaves, is not of much value. Then he showed us that when they exposed the raspberry canes to two types of weather, namely the temperatures and daylengths of summer and autumn respectively, they produced fruit buds in the axils of the leaves, but no side shoots, blossoms or fruits when plants were returned to summer conditions.

But when they gave the canes successive summer, autumn and cold winter conditions, the shoots were then capable of producing side shoots, flowers, and later, fruits. In other words, to get fruit the canes have to experience cold winter temperatures. We have always thought of the winter as terribly cold and nasty, but it looks as if it is completely necessary if we are going to have some raspberries to eat.

Now PROFESSOR HUDSON chose the raspberry as one example of the kinds of fruits we grow. The probability is that there are plenty of other fruits which behave in exactly the same way. Whilst we hate to have our cold winters, it may be very necessary if we want to eat fruit later on in the year.

Well, PROFESSOR HUDSON left it at that stage last time, a fortnight ago,

and he is now going to take up the story again, and I am sure he will have some further interesting facts to tell us about the effect of weather on the growing plant.

PROFESSOR J. P. HUDSON: The first lecture was concerned with the complexities of "the weather", and the ways in which the plant environment could be studied in order to find out the effects of weather on the two main aspects of plant behaviour, namely *development* and *growth*. We are still very far from a full understanding of the effects of each factor of the environment on plant responses, but knowledge is being accumulated rapidly, thanks to the use of controlled environments, which are greatly facilitating this type of research. We now know something about the effects of a few isolated factors on a few aspects of the behaviour of a few plants, which seems a rather unimpressive total of knowledge in view of the effort which has been devoted to the study of plants and the weather, but it is a useful beginning. One day, no doubt, the whole story will be revealed and it should then be possible to *specify* the conditions needed for heaviest yields, to *predict* the plant's behaviour under any type of weather conditions, and to *explain* in retrospect why plants behaved as they did in any particular season. But to specify, predict or explain will not increase crop yields. That can only come if we can *alter* the plant environment and provide the crop with a micro-climate (weather conditions) that more nearly match the needs of the plant. Thus the next step is to consider how far it is possible to alter the micro-climate.

METHODS OF MODIFYING THE PLANT ENVIRONMENT

Most of the environmental factors can be controlled to a greater or lesser extent, but at very different cost. A high degree of control may be achieved on a small scale in the laboratory or growth room, but the cost of doing so would make it impossibly expensive for crop production, although the cost for research is trifling in relation to the value of the results that can be obtained in controlled environments. On the other hand a partial, but useful, degree of control can be exercised over many factors of the environment on a commercial or garden scale.

The first, and most obvious, way of controlling the plant environment is the *passive* one, of choosing a site most suitable for the plant concerned or, alternatively, choosing the most suitable crop for any particular site.

Although it has been the pride of the British gardener that he would somehow manage to grow almost any plant from any part of the world, nevertheless the secret of successful gardening, and certainly of successful commercial horticulture, must be to choose crops and varieties that will succeed under the conditions that can most easily be provided for them—that is, varieties that will survive the worst weather that is likely to be experienced and thrive under the conditions that are most likely to occur.

The more active methods of altering the plant environment are listed below, roughly in increasing order of effectiveness and also in increasing order of cost.

Soil amelioration, including the improvement of structure, alteration of colour or reaction, addition of nutrients, deepening by cultivation, soil warming, drainage and irrigation, all of which alter the nature of the root environment.

Alteration of micro-climate in open ground, including the provision of shelter, wind-breaks, shade, ground covering (straw and other materials as mulches), earthing-up, application of mist, frost protection, and the use of artificial light.

Semi-opaque structures, such as brush houses, shade houses, and muslin or slatted covers, can be used to reduce intensity of light, day temperature and wind speed.

Low glass coverage, such as cloches, bell jars, Dutch light frames, and English frames, can be used to increase temperature, reduce wind speed and alter the distribution of rain.

Temporary glasshouses, such as giant cloches, Dutch light structures, and movable houses, either glazed or plastic covered, give some degree of control of humidity and wind speed, and enable temperature-regimes higher than ambient to be maintained, even without the use of heating.

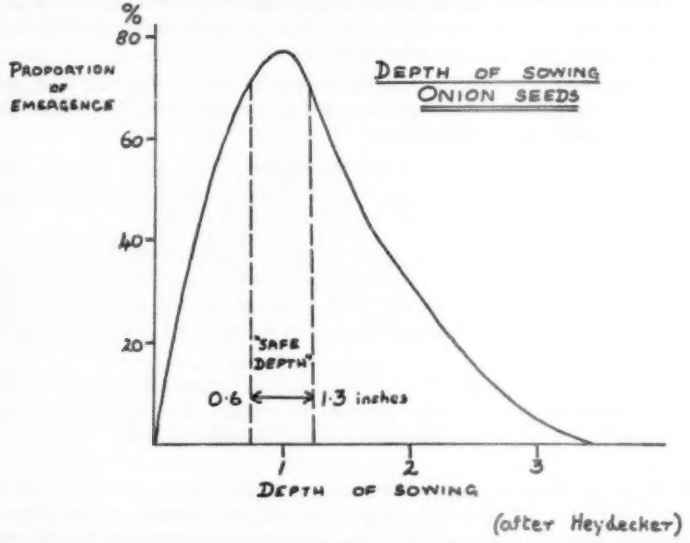
Permanent glasshouses, which may be unheated, heated or air-conditioned, give various degrees of control of light, temperature, humidity, rate of air change and possibly other factors.

Methods of controlling environment in horticultural practice are, of course, legion. Their success depends, first, on a precise knowledge of the plant's reaction to particular conditions and, second, on the practicability of altering the plant environment to produce the desired micro-climate. One or two examples can be cited to illustrate ways in which these two aspects can be married in practice.

To take a form of passive control, it is known that seeds sown in the soil require moisture, warmth and air to germinate successfully and give a satisfactory stand of seedlings. The condition of the soil can be seen at the time when seeds are due to be sown, and the wise gardener would postpone sowing rather than put seeds in a soil that is too wet or too dry or too cold or in poor physical condition. But even if the soil appears to be in good condition for sowing it is not known whether the weather will bring heavy rain or hot, drying winds in the critical time that will elapse before seedlings emerge. Thus sowing seeds is an act of faith in which we hope that soil conditions will remain suitable for long enough to allow seedlings to come through the soil. My colleague, DR. HEYDECKER, has shown that depth of sowing is critical—i.e. the choice of a suitable site for the seeds—since seeds sown too deep or too shallow are

likely to fail unless ideal weather follows sowing. For most successful germination, under a wide range of soil and (unpredictable) weather conditions, the "safe depth" for onions, lettuce, carrot and cabbage seed is 0·6–1·0 inches (Text Fig. 1, Heydecker, 1956), and the aim in sowing should be to place all the seeds within this narrow range of depths.

Turning to amelioration of the soil, it is often claimed that the use of soot in Bedfordshire market gardens results in an increase of soil temperature due to the greater capacity of dark soil to absorb and retain



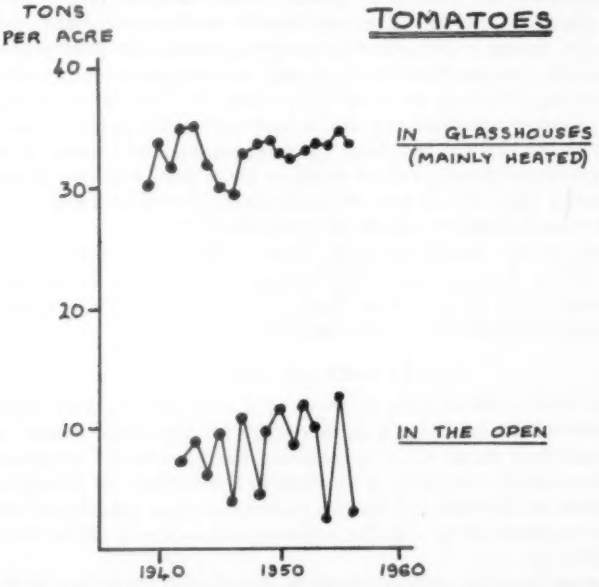
TEXT FIG. 1—The relation between depth of sowing onion seeds and the proportion of seedlings which emerge under a wide range of weather conditions.

the sun's heat. A more positive form of soil warming is the use of pipe heating in hyacinth bulb fields in Holland, in the open, to raise the temperature of the soil *before the bulbs are lifted*, in order to hasten the development and maturing of the bulbs so that they are capable of being forced into flower in time for the following Christmas markets. The cost of heating soil in the open field is, of course, very heavy, but is justified by the high value of the product.

Regarding shelter and shade, much use is made of wind-breaks in the more exposed districts, but gardeners often over-estimate the value of solid shelter, which creates intense local turbulence and may lead to more damage than it prevents. A semi-permeable form of shelter, that reduces air speed by filtering rather than blocking the wind, is far more effective. Shade is rarely used deliberately in the open in Britain, except

in woodland gardens, but unglazed, slatted shade houses are often seen in New Zealand, where they are used to grow an attractive range of species requiring low light intensity and moist conditions.

The outstanding method of altering the plant environment on a large scale is, of course, the heated glasshouse. Although expensive, such houses enable very heavy yields indeed to be produced with great regularity (Text Fig. 2) but there is need for research on the relations



TEXT FIG. 2—Yields of tomatoes under glass and in the open in England and Wales (M.A.F.F. Statistics), showing not only the heavier yields obtained under glass but also the much greater regularity of cropping between successive years because of the lower degree of dependence on weather conditions. Fluctuations in the earlier years under glass were associated with fuel shortages during and after the war.

between glasshouse plants and their environment, since a more precise knowledge of that relationship may enable still heavier yields to be obtained at economic costs. Although some work has already been done, notably on water relations and the effects of temperature and light on young plants, there are serious gaps in our knowledge and more information is urgently needed about those factors of the environment which are most readily controllable in practice. For instance, there are conflicting views on the best night temperature for growth and development of tomato and cucumber plants. Since this factor is known to have a profound effect on yield, and is fairly readily controllable, there is urgent

need for more precise information about the optimal temperatures, at various stages in growth and in relation to the current weather. Although many growers produce heavy, regular crops under glass there is no evidence that the present methods are best, and it might be possible to increase yields substantially by more accurate control of night temperature, at little extra cost.

Turning to light, the present methods of controlling light intensity in glasshouses are extremely crude. Until electric power becomes much cheaper it may be impracticable to increase light intensity except for young plants spaced closely together, but it is possible to reduce light intensity if there is any advantage in doing so. The evidence suggests that, for most of the time, the light intensity in glasshouses is below optimum but that it may exceed the optimum for short periods in hot, sunny weather. Optimum intensities should be ascertained by experiment, to show whether there would be any advantage in reducing light, by the use of blinds or other methods and, if so, the level at which intensity should be controlled.

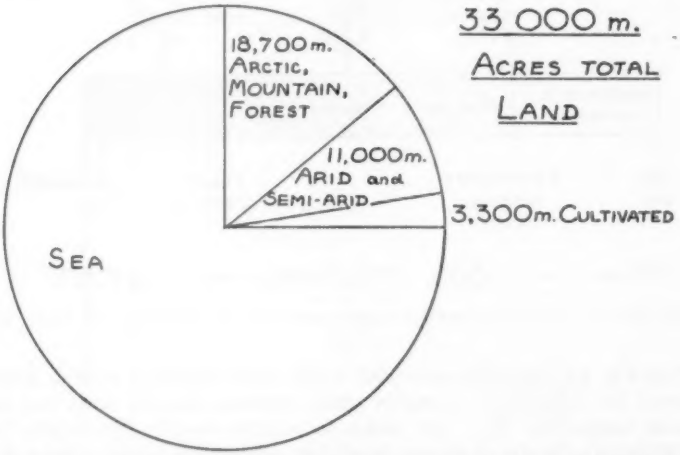
Work is also needed to show whether humidity control would be worth while. Present indications are that this factor is not of great importance over quite a wide range, provided other factors are satisfactory, but the position needs clarifying.

IMPORTANCE OF IRRIGATION

Despite the interest of these methods of altering the plant environment, the factor which lends itself most readily to large-scale control is soil water, and it is worth while considering the question of irrigation in a little more detail—not only in relation to horticulture in Britain but in the context of the much wider and more important question of increasing food production on a global scale from the drier parts of the world (Text Fig. 3).

No less than 200 million acres of agricultural land throughout the world are at present dependent on irrigation for successful crop husbandry, and nearly a fifth of the world's population relies on food from irrigated land. Most of this area lies in arid and semi-arid regions where irrigation is a substitute for rain, and where little or nothing would grow without artificial supplies of water, but increasing importance attaches to irrigation even in humid regions like our own. Although plants require a continuous supply of readily-available water, in Britain rainfall usually supplies about enough water for plant growth, since moisture stored in the soil can supply the plants' needs from one rainfall to the next—that is, the soil acts as a buffer against short periods of drought. However, if rain does not fall for a number of days, the reserves of soil moisture are gradually used up, and plants stop growing. If the drought continues for long enough plants wilt, and ultimately die, although that rarely happens in this country. However, it is becoming apparent that irrigation could often be used to supplement rain and increase crop yields, even in Britain.

Although MR. E. J. WINTER spoke about "The Watering of Field and Glasshouse Crops" in the Masters Memorial Lectures as recently as 1957, it is worth while to look again at some aspects of this important question, in which ideas are developing very rapidly. The plant/soil/water system is highly complex and dynamic, not static. Most of the water which is taken up enters the plant through the younger parts of the root system, and since each root is elongating, it follows that the assimilating part occupies different areas of soil at different stages in its growth. A useful concept is that, in the earlier stages of establishment, the root system of a plant occupies an increasing volume of soil (the rooting zone) as roots grow out into new areas of soil. At a later stage,



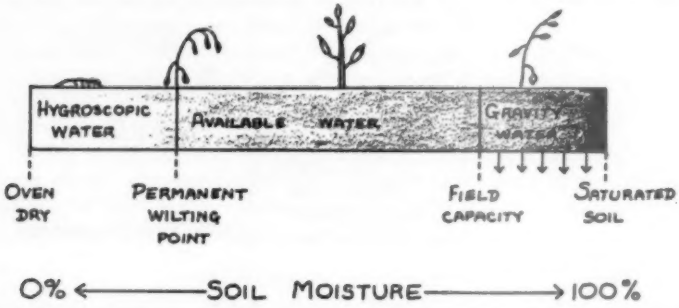
TEXT FIG. 3—Diagram showing the small proportion of the earth's surface at present cultivated and the much larger area of arid and semi-arid land that could be used for agricultural production if irrigation water could be made available.

when the root system is fully established, the whole available rooting zone is occupied by wave after wave of new roots, but the total volume of the rooting zone remains constant. These two conditions, which are vital to the understanding of the relationship between plant and water, have been referred to as Phases 1 and 2 of rooting (Majmudar and Hudson, 1957).

Turning to the relation between soil and water (Text Fig. 4), the water in a soil can roughly be classified into that part which is held so tightly that it is unavailable to plants, since their roots cannot take it up (*hygroscopic water*); water which will run out under the influence of gravity, and is normally unimportant in well-drained soil, since it is purely transient (*gravity water*); and the all-important water which the soil can retain against gravity, but which is available to plant roots

(*available water*). The upper and lower limits of the available range are set by two ill-defined, but convenient, conditions known respectively as *field capacity*, where water ceases to run out of a well-drained soil, and *permanent wilting percentage* at which roots can no longer extract enough water to keep most plants rigid.

Water is present as a film around the soil particles and these films naturally become thinner as a soil dries out. This affects *soil moisture tension*, which is a measure of the surface forces acting upon the water that is helpful in the proper understanding of the relation between water and plant behaviour. Tension increases as a soil dries out, slowly at first but with increasing rapidity as the soil becomes drier



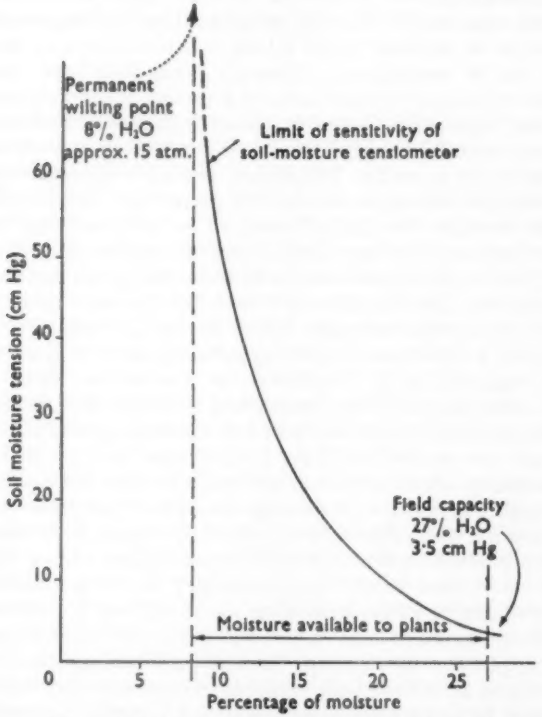
TEXT FIG. 4—Diagram showing a convenient way of classifying the water in a soil.

(Text Fig. 5). Since the ease with which water enters a root is determined by differences in energy status between the soil water and the fluids inside the root, the moisture tension largely determines the availability of water to plants (in all but saline soils, which offer a different problem not considered here) and it becomes obvious that water is not *equally* available to plants throughout the available range.

WATER AND PLANT GROWTH

In relating water and plant growth three conditions of soil moisture are of interest, namely the degree of wetness of the soil, its degree of dryness, and the degree of availability of the water to plants (Hudson, 1957). Each of these three can be measured separately (Geary, 1956) although it is not necessary to consider the methods in detail, and all three attributes have to be taken into account in developing a rational system of irrigation control. The *degree of wetness*, although the most obvious of the three attributes, is perhaps the least significant in horticulture, since it indicates only the total amount of water which is still available in the whole rooting zone, but without reference to the ease with which plants can take it up. If all the soil is already occupied by roots (Phase 2), plants will find increasing difficulty in extracting more water as the soil dries out further, but if only part of the soil is occupied (Phase 1),

the unoccupied parts outside the rooting zone may contain ample readily-available water, even though the roots have already dried out the occupied volume. Thus, after a given period of time from the last irrigation, all the roots of a plant in Phase 2 may be experiencing moderate tensions whereas the extending roots of a plant in Phase 1 can still gain access to water at a low tension. The *degree of dryness* refers to



TEXT FIG. 5—The relation between soil moisture tension and the amount of water in a coarse sandy loam soil at Sutton Bonington.

the amount of water which would have to be added to a soil to re-wet it to any particular moisture condition as, for instance, to replace all the water which has been lost since the last irrigation. The degree of dryness is usually quoted as the amount of water needed to re-wet all the soil to field capacity. The *degree of availability* is all-important, since it determines whether or not plants can take up water easily enough for optimal growth, and measurement of moisture tension is the best guide to this attribute in normal soils which contain relatively low concentrations of soluble salts.

Although these three attributes have separate physiological and horticultural significances there is, of course, a connection between them, but the precise relation between moisture tension and moisture percentage is determined by the nature and texture of the soil (Text Fig. 5). Once this relation has been worked out for any particular soil it is a simple matter to calculate values for any two of the attributes if the third is known.

An understanding of the soil/water relation still leaves one more component to be assessed before a fully effective system of controlling irrigation can be worked out. Although it has long been understood that moisture tension increases as a soil dries out, it is only recently that research has begun to indicate the moisture tensions at which various crop plants should be irrigated, to prevent their growth from being impeded by moisture stress. *Plants show no easily-recognizable symptoms of stress until the soil approaches wilting percentage, by which time their growth has probably been seriously reduced, so the plant itself cannot be used as an indicator of its own optimal needs for water.* Indeed, a review of most of the available experimental evidence has shown that the growth rate of many crop plants is reduced at quite low moisture tensions (Stanhill, 1957), but specific tolerance levels have so far been worked out in detail for only a few of the many irrigated crop plants (e.g. for tomatoes by Salter, 1954 and 1957). Moreover, there is no one "best" time for irrigation, since plants such as lettuce and tomatoes seem likely to produce better crops if the soil is allowed to develop high tensions around part of their root systems in Phase 1, when new roots are still growing freely into soil which contains readily available water, during which time slight droughting tends to encourage better root systems. At a later stage (Phase 2), when the soil has been fully occupied by roots, these same plants become intolerant of high tensions in any part of the rooting zone. In such cases it may be unnecessary, or even undesirable, to irrigate at all during Phase 1, whereas the plants can only be expected to yield their maximum crops if watered frequently in Phase 2. These findings suggest that the "average" conditions of soil moisture throughout the rooting zone have little meaning in relation to plant behaviour. Growth may be unimpeded if part of a root system is in contact with soil at a high tension, provided other parts have access to water at a low tension, whereas growth may suffer if all the roots are in contact with soil at a medium tension.

One further aspect must be considered before discussing practical applications, namely the rate of water loss from a soil. Excluding gravity water which runs to drainage, the main loss of water from a soil is either due to evaporation from the surface or the uptake of water by plants, which subsequently lose most of the moisture from the leaves in the process of transpiration. These two components can be added together to give total evapo-transpiration, the rate of which is largely determined by climatic conditions and the proportion of the soil which is covered by plants. Penman (1956) has shown that the rate of water

loss from a full cover of vegetation, growing in soil where water is freely available to the roots, can be determined within a useful degree of accuracy by a simple calculation based on readily-recorded meteorological data, giving a figure for *potential evapo-transpiration*. If this figure is combined with records of rainfall it is easy to work out a water budget which will show, at any time, the *water deficit* (degree of dryness), i.e. the amount of water which would have to be applied to re-wet the soil to field capacity (Pearl, 1954).

PRACTICAL APPLICATIONS

Turning to the practical aspects of irrigation, a fully effective programme requires information about (*a*) the critical moisture tension in each successive phase of development of the crop plant, (*b*) the characteristic curve of the soil (Text Fig. 5), and (*c*) the current water deficit. With this information a rational system of irrigation can be pursued with the minimum of measurement in the field although, of course, the research on which the original data were based may have required very detailed experimental work. For any particular crop plant, the length of each phase of development is likely to vary little from one year to the next, and the critical tension at which water must be applied will be the same from one season to another and in most soil types although, of course, the amount of water required to effect any particular change in moisture tension will vary considerably between one soil and another, according to differences in their moisture-holding properties.

Once the plant and soil characteristics are known, and the dynamics of the situation appreciated, it would not be difficult to prepare a schedule, for each crop and each soil type, showing the maximum water deficit that could be allowed to build up at each phase of growth before water need be applied. It might be asked how this is likely to benefit the horticulturist? Can the use of such information produce any better crops than the present system of irrigation, based on experience and judgment? Although irrigation is an old and well-established practice, producing spectacular results in arid climates and useful results in many years in the drier parts of Britain, the application of water is still based largely on empiricism. Because of the tolerance of plants to sub-optimal moisture conditions, and the buffering action of the soil, reasonable yields can often be obtained from incorrect applications of water, either in the wrong amounts, or at the wrong time, but there is growing evidence that more careful control of water supplies might enable significantly heavier yields to be produced without necessarily increasing the consumption of water.

With the increasing use of irrigation, either as an aid to heavier production in humid climates or to make crop husbandry possible in arid and semi-arid areas, the importance of water as a natural resource seems likely to become more and more apparent. It is essential that its use for irrigation should be strictly controlled, to ensure that this resource is

used to best advantage and to enable each grower to make the maximum possible contribution to increasing production.

Where growers draw their supplies from *in situ* sources, such as pumps or wells under their own control, both the costs and the demands on underground water reserves can be minimized by this approach to control of irrigation, but the problem is more difficult in large irrigation schemes where water is allocated by a central authority. In such cases administration is eased if water can be made available in fixed amounts, and at fixed intervals of time, but it seems likely that this may often conflict with the day-to-day needs of a particular crop, which may respond differently to moisture tension at different phases in its development. This aspect deserves the most careful study, in the light of accumulating knowledge of the precise requirements of crop plants.

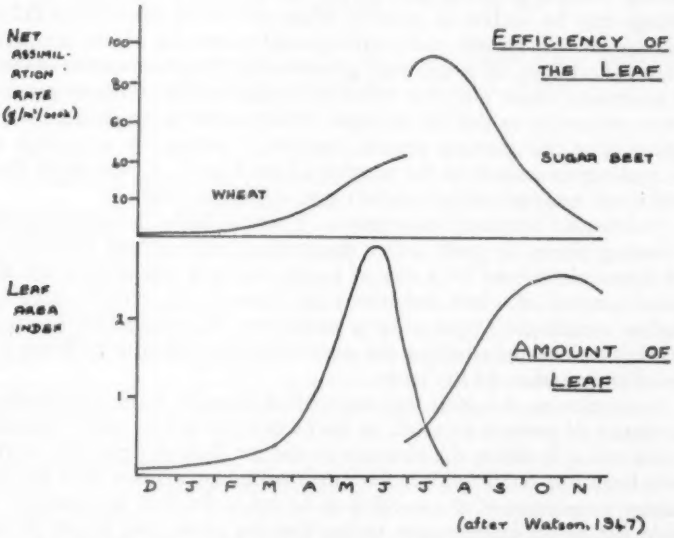
ALTERING PLANT RESPONSES TO WEATHER

So much for the question of altering the weather as it affects plants. Except for the special case of irrigation the present position is frustrating, since it seems unlikely that we shall be able to control weather factors such as light and temperature on a field scale. However, there is another possibility. Although it may not be practicable to alter the behaviour of plants in the field by altering their environment, might it not be possible to alter the plant's response to weather? The use of a chemical treatment to alter responses to temperature or daylength would be much more elegant than to try to alter those factors on a field scale, and would be the biggest "break through" in agriculture since the discovery of fertilizers a hundred years ago.

Our own interest in this field arose from studies of the development of raspberry shoots (referred to earlier) in which it proved possible to bring plants into any particular phase at will, and to keep them in that phase more or less indefinitely, by the use of suitable controlled environments. The question obviously arose whether such plants could be induced to pass into the next phase by any form of treatment, but without changing the environmental conditions, and it was decided to investigate this possibility, which has important cultural implications.

The rosetted raspberry shoot has been chosen for most of this work, since it is at that time "ripe to proceed" but is prevented from growing into a vigorously elongating leafy shoot by adverse weather conditions. In most of the experiments raspberry plants have been grown at 64° F. and 12 hour days, until they have formed shoots a few inches long. They have then been put under cooler, short-day conditions where they cease to elongate within a few days and form terminal rosettes of leaves. Thereafter the shoots remain in the rosetted condition for many months, slowly unfolding new leaves but with no elongation of the internodes. Various chemicals have been applied to the stem apices (Cook, 1958), with outstanding results from that remarkable substance, gibberellic acid (Fig. 162). If elongating plants are put into the "rosetting" environment and are immediately given weekly treatments of gibberellic acid

they continue to elongate steadily, instead of forming a rosette. On the other hand, if plants are allowed to form rosettes and are then given similar treatment they recommence to elongate at once. If the applications cease, the effect of the gibberellic acid wears off within a few weeks and the shoot once more rosettes, while reintroduction of the treatment a few weeks later causes elongation to recommence, with further leaf expansion, and so on. Thus, weekly applications of gibberellic acid at a low concentration will prevent raspberry shoots from rosetting, or will



TEXT FIG. 6—Data comparing the efficiency of the leaf with the amount of leaf at various stages of growth in sugar beet and wheat. Whereas wheat plants have the maximum leaf area at a time when efficiency is highest, beet plants do not develop maximum leaf area until long after the peak of efficiency has been passed. Any treatment that would cause beet plants to produce a larger leaf area earlier in the season would probably lead to substantial increases in yield.

cause rosetted shoots to recommence elongation, under environmental conditions which would normally induce rosetting. Treatment with gibberellic acid, particularly after rosetting, also has the effect of stimulating the basal bud into growth, even though no acid is at any time applied to that bud or shoot (Fig. 162*c*) and there is a curious tendency for the new basal shoot to continue to elongate even after treatment with gibberellic acid has ceased and the original shoot has reverted to the rosetted condition (Fig. 162*d*).

The importance of these results is that treatment with gibberellic acid *changes the reaction of the plant to its environment*, in this case

causing a shoot to grow (that is, increase in length and leaf area) under weather conditions which would normally prevent that from happening. By the use of appropriate dosages the growth made under the stimulus of gibberellic acid appears to be quite normal and healthy (Fig. 162*b*). It is not difficult to see the significance of these results. For various reasons, such as risk of late frost or technical difficulties of cultivation, it is often necessary to delay the sowing or planting of crops such as sugar beet, which make slow growth at first and may still be small when optimal growing conditions occur later in the season (Watson, 1956). Earlier sowings may be useless in practice, since the young plants may fail to make appreciable growth under sub-optimal conditions of low temperatures or short days. If at this stage growth could be stimulated by chemical treatment under *marginal* weather conditions, but without causing flower primordia to initiate, a larger plant might be produced by the beginning of the growing season, capable of taking full advantage of seasonal improvements in the weather (Text Fig. 6). Crops might then make more total growth or might ripen earlier, or both.

The word "marginal" is stressed. There is likely to be little profit in forcing plants to grow under dangerously sub-optimal conditions, and there might even be a risk of losing the crop altogether; but the careful control of plant behaviour in response to certain marginal weather conditions might offer a technique of considerable practical value in horticulture, enabling the grower for the first time to break the grip of the weather on his crops.

In conclusion, it is clear that the relation between plants and weather is a matter of concern to us all, as horticulturists and as world citizens, since it not only affects the pleasure we can get from our gardens, or the profit from our holdings, but the much wider question of how the increasing population of the world is to be fed in the next generation. It would not be an exaggeration to say that the peace and future of the world may depend on man's skill and ingenuity in producing more food, and producing it quickly enough to keep pace with the increasing world population. One way of helping to win this struggle for existence, which is likely to be the central problem in the next generation, is to seek a better understanding of the effects of weather on the behaviour of plants.

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THE CHAIRMAN: Do you wish to ask Professor Hudson any questions? The use of gibberellic acid is a new idea to a lot of people.

A LADY MEMBER: How does it affect the fruit?

PROFESSOR HUDSON: In our case, the work has not gone as far as that. I should explain that gibberellic acid is a naturally occurring plant hormone. Either gibberellic acid, or something similar, is already present in the plant so we are not offering the plant something abnormal: we are only altering the amount in the plant. Thus the use of gibberellic acid is quite different from using a fertilizer. The plant is dependent on outside sources for its fertilizers. Therefore it is bound to respond to fertilizer application if it is short of nutrient, but in the case of gibberellic acid, and other similar chemical modulators, we are applying something to the plant which is already there, and are altering the nicely balanced complex of hormones which regulate the plant behaviour.

It is very easy to get plants to do ridiculous things by applying chemical regulators in the wrong amounts, and to throw plants out of balance. All we have demonstrated so far is that there is a connection between the chemical balance in the plant and its responses to weather. You can alter at least some of the plant's responses to weather by applying chemical modulators of the gibberellic acid type.

I have no reason to suppose that gibberellic acid would affect the fruit at all. The fruiting laterals of raspberry canes can be stimulated into growth by chemical treatment, but we must be careful not to make the plant do silly things, or it will probably not be of any use to us at all. The whole complex relation between weather and plants, as illustrated by the relation between the raspberry plant and autumn and winter conditions, is a precisely controlled natural system of checks to ensure that the raspberry buds will not start to grow out during warm days in winter, until they have had a certain amount of cold to break dormancy. That is a good example of Nature's checks to ensure that plants do the right thing at the right time of the year. If we find that, by chemical treatments, we can make plants do the wrong thing at the right time of the year, we shall have to use that knowledge very carefully or we may find we have spoiled the plant altogether.

Here is a new tool in our armoury as plant managers, which we must

learn how to use to our advantage and that offers a very stimulating challenge.

DR. LAKE: Making use of this idea, I can see a possibility like altering the flowering of chrysanthemums; we can already make chrysanthemums flower all the year. Have you anything comparable in mind for the tomato, to produce better yields or would that be an optimistic "castle in the air"?

PROFESSOR HUDSON: In choosing a line of work, one always has something in mind that will make it worth while if it should come off. The thing we have in mind is this: WATSON's work at Rothamsted has shown very clearly that the rate of leaf growth and rate of photosynthesis of plants is different at different times of the year, and with a crop like sugar beet the rate at which it can utilize or fix energy is highest at the time when it has rather few leaves. At a later part of the season, when the sugar beet plant has a large number of leaves, its capacity for assimilation is low. If one could, in those circumstances, induce a young plant to form a larger leaf system earlier in the year than it normally would, then the plant should be capable of taking better advantage of optimal conditions when they come. We have an idea that a use for gibberellic acid and chemical modulators would be to hasten development of young plants earlier in the season so that they have a larger leaf system when weather conditions improve.

THE CHAIRMAN: I am sure you would like to thank PROFESSOR HUDSON through me for coming from Nottingham to talk about this rather unusual subject. Both meetings have been very interesting and stimulating. We have certainly all thought the lectures worth while, PROFESSOR HUDSON, and we hope you have thought it worth while to deliver them.

The motion of thanks was carried with acclamation, and the proceedings then terminated.

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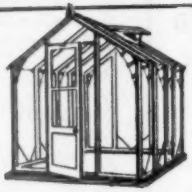

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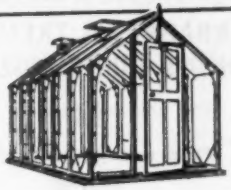

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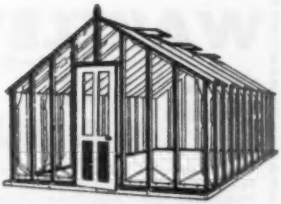

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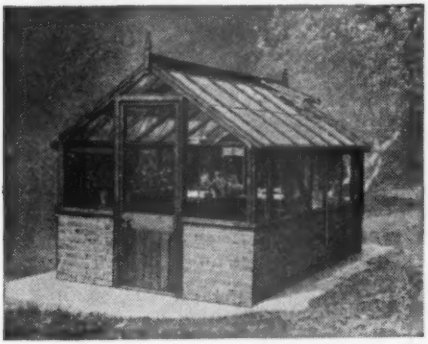

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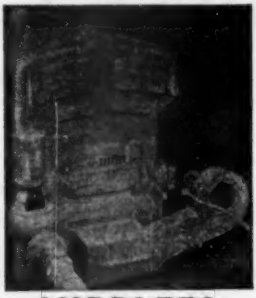

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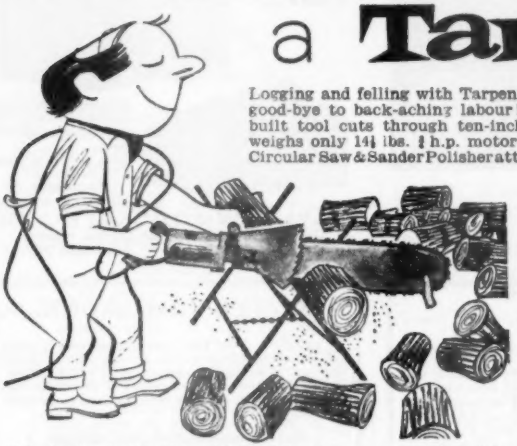

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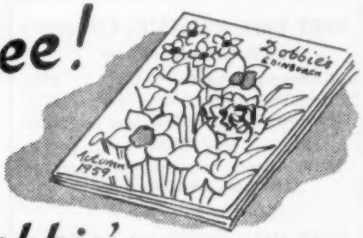

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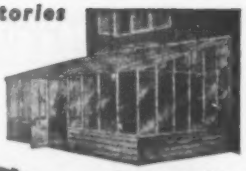

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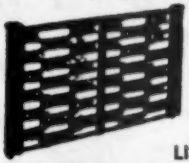

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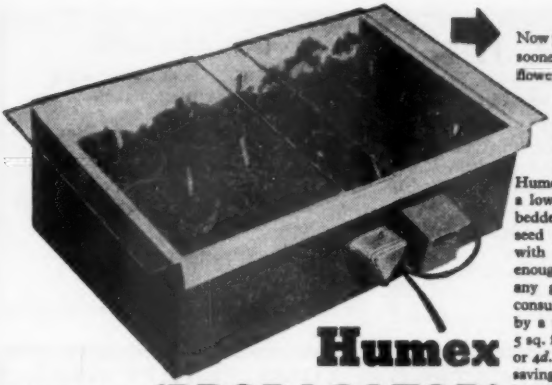

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